

3-A
PROJECT DESCRIPTION:
TREATMENT PLANT

**FINAL
ENVIRONMENTAL
IMPACT STATEMENT**

**Brightwater
Regional Wastewater
Treatment System**

APPENDICES

Final

Appendix 3-A Project Description: Treatment Plant

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King County

Department of Natural Resources and Parks
Wastewater Treatment Division

TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	CHANGES FROM DRAFT EIS FOR BOTH SITES.....	2
3	DESIGN CRITERIA.....	2
3.1	CAPACITY.....	2
3.2	INFLUENT WASTEWATER CHARACTERISTICS	3
3.3	EFFLUENT LIMITS.....	4
3.4	SOLIDS TREATMENT	4
3.5	RECLAIMED WATER	5
4	TREATMENT PROCESSES.....	6
4.1	LIQUID TREATMENT PROCESS SUMMARY	7
4.2	SOLIDS PROCESSING AND BIOSOLIDS MANAGEMENT.....	10
4.3	ODOR CONTROL	12
4.4	NON-PROCESS AND AUXILIARY FACILITIES	12
4.5	ENERGY CONSUMPTION AND GENERATION.....	13
4.6	AUXILIARY FACILITIES.....	15
5	HANDLING EMERGENCY OVERFLOWS.....	15
6	LAYOUT DESCRIPTION	16
7	ROUTE 9 TREATMENT PLANT FEATURES	17
7.2	SITE LAYOUT	18
7.3	CHANGES FROM THE DRAFT EIS.....	19
8	UNOCAL TREATMENT PLANT FEATURES	20
8.1	SITE LOCATION AND CHARACTERISTICS	21
8.2	SITE LAYOUT	21
8.3	CHANGES FROM THE DRAFT EIS	22
8.4	SUB-ALTERNATIVES.....	23
	REFERENCES	24
	ATTACHMENTS.....	25
	ATTACHMENT A – PROJECT DESCRIPTION SUMMARY	
	ATTACHMENT B – DESIGN CRITERIA	
	ATTACHMENT C – LAYOUTS	
	ATTACHMENT D – SECTIONS	
	ATTACHMENT E – PROCESS FLOW SCHEMATICS	
	ATTACHMENT F – PLANT SITE AREAS	
	ATTACHMENT G – ENERGY REQUIREMENTS	
	ATTACHMENT H – ENERGY RECOVERY POTENTIAL FROM BIOGAS	
	ATTACHMENT I – CUT AND FILL QUANTITIES	
	ATTACHMENT J – TRUCK TRIPS FOR PLANT OPERATION	
	ATTACHMENT K – LID SUB-ALTERNATIVE FOR THE UNOCAL SITE	
	ATTACHMENT L – PINE STREET RELOCATION EVALUATION	
	ATTACHMENT M – UNOCAL PILE FOUNDATION	

TABLES

Table 1	Brightwater Treatment Plan Design Capacity
Table 2	Influent Wastewater Characteristics for Average Wet-Weather Conditions
Table 3	Technology-Based Effluent Limits for Secondary Treatment
Table 4	Biosolids Classifications Using Anaerobic Digestion
Table 5	Classes of Reclaimed Water and End Users
Table 6	Effluent Standards for Class A Reclaimed Water
Table 7	Effluent Quality for CAS and MBR
Table 8	Estimated Energy Demand and Energy Consumption

King County has prepared a Draft Environmental Impact Statement (Draft EIS) and Final Environmental Impact Statement (Final EIS) on the Brightwater Regional Wastewater Treatment System. The Final EIS is intended to provide decision-makers, regulatory agencies, and the public with information regarding the probable significant adverse impacts of the Brightwater proposal and identify alternatives and reasonable mitigation measures.

King County Executive Ron Sims has identified a preferred alternative, which is outlined in the Final EIS. This preferred alternative is for public information only, and is not intended in any way to prejudge the County's final decision, which will be made following the issuance of the Final EIS with accompanying technical appendices, comments on the Draft EIS and responses from King County, and additional supporting information. After issuance of the Final EIS, the King County Executive will select final locations for a treatment plant, marine outfall, and associated conveyances.

The County Executive authorized the preparation of a set of Technical Reports, in support of the Final EIS. These reports represent a substantial volume of additional investigation on the identified Brightwater alternatives, as appropriate, to identify probable significant adverse environmental impacts as required by the State Environmental Policy Act (SEPA). The collection of pertinent information and evaluation of impacts and mitigation measures on the Brightwater proposal is an ongoing process. The Final EIS incorporates this updated information and additional analysis of the probable significant adverse environmental impacts of the Brightwater alternatives, along with identification of reasonable mitigation measures. Additional evaluation will continue as part of meeting federal, state, and local permitting requirements.

Thus, the readers of this Technical Report should take into account the preliminary nature of the data contained herein, as well as the fact that new information relating to Brightwater may become available as the permit process gets underway. It is released at this time as part of King County's commitment to share information with the public as it is being developed.

1 INTRODUCTION

King County proposes to build the Brightwater Regional Wastewater Treatment System to serve residents of north King and south Snohomish Counties. The plant, as identified in the Draft Environmental Impact Statement (EIS), would be at one of two locations: the Unocal site in Edmonds or the Route 9 site in unincorporated Snohomish County. By 2010, the plant would have the capacity to provide secondary treatment of an average of 36 million gallons per day (mgd) of wastewater. By 2040, the capacity would be expanded to 54 mgd. These capacities are for average wet-weather flows (AWWF). The plant must also be able to accommodate a peak hourly flow of 130 mgd by 2010 and 170 mgd by 2040.

Two sub-alternatives are considered for the Unocal site. One is to build a structural lid over the plant to accommodate Edmonds Crossing, the proposed multimodal transportation center. The other sub-alternative is to treat wastewater that currently flows to treatment plants operated by the Cities of Edmonds and Lynnwood; this would require

expansion of Brightwater's capacity to 72 mgd AWWF and peak hourly flows of 235 mgd. No sub-alternatives are considered for the Route 9 site.

This appendix describes the proposed wastewater treatment facilities. The treatment processes are similar for either the Unocal or Route 9 site, with variations due to individual site characteristics. The treated effluent would meet or exceed the secondary treatment standards of the Washington Department of Ecology (Ecology).

A tabular summary of the plant facilities and operations is given in Attachment A.

2 CHANGES FROM DRAFT EIS FOR BOTH SITES

Since publication of the Draft EIS, a number of the treatment process units have been refined or modified based on evaluations conducted during ongoing predesign activities. The two significant areas of change are as follows:

- **Split-flow membrane bioreactor (MBR).** A full-flow conventional activated sludge (CAS) process was proposed in the Draft EIS. The treatment plant process units were sized hydraulically to handle the peak hourly flow at buildout of 170 mgd with a buildout AWWF of 54 mgd. Various alternatives for the secondary process were considered during predesign, and a split-flow MBR was selected as the preferred alternative because it provides substantially better effluent quality. The MBR process is a split-flow process due to the limited peaking capacity of the membrane system. Flows above the design threshold would be split downstream from preliminary treatment, processed in a ballasted sedimentation system, and recombined with MBR effluent for disinfection and discharge to Puget Sound. The design threshold is set at a level to ensure discharge permit compliance for effluent biochemical oxygen demand (BOD₅) and total suspended solids (TSS) concentrations and percent removals.
- **Filtration.** The Draft EIS included facilities for effluent filtration for reuse using granular filtration of CAS effluent. This is no longer needed because the MBR produces filtered effluent and no additional filtration is required to produce Class A reclaimed water.

Several other site-specific changes have been made; these are described later in this document in the sections describing each site.

3 DESIGN CRITERIA

3.1 Capacity

The design wastewater flow capacities are the same for both sites, Route 9 and Unocal. However, in addition to the baseflow, the Unocal site has the sub-alternative of accommodating wastewater now going to the Edmonds and Lynnwood treatment plants. The added flow would require greater capacity (72 mgd). The design capacities for the two sites are compared in Table 1.

TABLE 1
Brightwater Treatment Plant Design Capacity

	Base Case – Unocal and Route 9	Unocal – 72-mgd Sub-Alternative
Phase 1 (2010)		
Average annual flow	31 mgd	31 mgd
Average wet-weather flow	36 mgd	36 mgd
Split-flow threshold	38 mgd through MBR process Sustained flows > 38 mgd with peak flows of 92 mgd through ballasted sedimentation process	38 mgd through MBR process Sustained flows > 38 mgd with peak flows of 92 mgd through ballasted sedimentation process
Peak-hour flow	130 mgd	130 mgd
Phase 2 (2040)		
Average annual flow	47 mgd	62 mgd
Average wet-weather flow	54 mgd	72 mgd
Split-flow threshold	56 mgd through MBR process Sustained flows > 56 mgd with peak flows of 114 mgd through ballasted sedimentation process	76 mgd through MBR process Sustained flows > 76 mgd with peak flows of 159 mgd through ballasted sedimentation process
Peak-hour flow	170 mgd	235 mgd

3.2 Influent Wastewater Characteristics

Influent water quality data from the existing West Point and South Treatment Plants, as well as flow and wasteload projections, were used as the basis for defining the design influent wastewater characteristics. Table 2 summarizes the influent wastewater characteristics of the Brightwater plant.

TABLE 2
Influent Wastewater Characteristics for Average Wet-Weather Conditions

Parameter^a	Route 9 and Unocal Base Case		Unocal Sub-Alternative
	At 36 mgd	At 54 mgd	At 72 mgd
BOD ₅ (lb/day)	60,000	90,000	120,000
Soluble BOD ₅ (lb/day)	23,000	35,000	46,000
TSS (lb/day)	62,000	93,000	124,000
NH ₃ -N (lb/day)	5,800	8,600	11,600
TKN (lb/day)	10,600	16,000	21,200
Total P (lb/day)	2,000	3,000	4,000
Temperature	14.0°C	14.0°C	14.0°C
pH	6 to 9	6 to 9	6 to 9
Fecal Coliform Bacteria Count (MPN/100 mL)	10 ⁷ -10 ⁸	10 ⁷ -10 ⁸	10 ⁷ -10 ⁸

^a Abbreviations: BOD₅ = biochemical oxygen demand; °C = degrees Celsius; MPN = most probable number (of organisms); NH₃-N = ammonia + ammonium nitrogen; TKN = total Kjeldahl; P = phosphorus; TSS = total suspended solids

3.3 Effluent Limits

Technology-based effluent limits for municipal wastewater treatment plants must comply with the Code of Federal Regulations, 40 CFR 133, and with the Washington Administrative Code, WAC 173-221. Secondary treatment typically is required to meet the limits for conventional parameters as listed in Table 3.

TABLE 3
Technology-Based Effluent Limits for Secondary Treatment

Parameter		Criteria
pH	6 to 9	
BOD ₅ (mg/L)	<ul style="list-style-type: none"> Average monthly limit is the more stringent of: 30 or < 15% of the average influent concentration Average weekly limit: 45 	
TSS (mg/L)	<ul style="list-style-type: none"> Average monthly limit is the more stringent of: 30 or < 15% of the average influent concentration Average weekly limit: 45 	
Fecal Coliform (MPN/100 mL)	<ul style="list-style-type: none"> Monthly geometric mean: 200 Weekly geometric mean: 400 	

3.4 Solids Treatment

King County is considering two different classes of biosolids:

- Class B** biosolids have been treated and stabilized to reduce pathogens but may still contain low levels of pathogens. The remaining pathogens die after land application. Use of Class B biosolids requires temporary public access restrictions, buffers from waterways and other sensitive areas, and restrictions on certain crops.
- Class A** biosolids receive further treatment and contain no detectable levels of pathogens.

Both classes require treatment to reduce vector attraction, and both must meet metal standards of the U.S. Environmental Protection Agency (EPA) and Ecology. In addition, both Class A and Class B biosolids require agronomic application rates that meet the nitrogen needs of the crop.

The different methods of stabilizing biosolids include digestion (aerobic and anaerobic), composting, and lime addition; anaerobic digestion is the most common method. The different classes of biosolids produced through anaerobic digestion can be used for different purposes as described in Table 4.

King County currently produces Class B biosolids at the West Point and South Treatment Plants. Class B is also assumed for Brightwater, with site flexibility to upgrade to Class A in the future. King County's Class B biosolids are currently used in three ways: agronomic land application in Eastern Washington, forestland application, and composting in Western Washington. While biosolids can also be disposed of by incineration, the County does not incinerate biosolids and this is not anticipated for Brightwater. Disposal of biosolids in landfill is not allowed by Ecology except in emergencies.

TABLE 4
Biosolids Classifications Using Anaerobic Digestion

Type of Biosolid	Type of Digestion Used by King County	Temperature (°F)	Solids Detention Time (days)	End Use
Class B	Mesophilic anaerobic	85 to 104	10 to 20 (high rate) 30 to 60 (low rate)	Composting; and land application for agriculture and forestry (buffer requirements, public access, and crop harvesting restrictions)
Class A	Thermophilic anaerobic (future)	122 to 140	≤ 10 days	Composting; and land application for agriculture and forestry (no buffer requirements, crop type, crop harvesting or site access restrictions)

3.5 Reclaimed Water

The Washington Departments of Health and Ecology issued the Water Reclamation and Reuse Standards in September 1997 (Health/Ecology, 1997); these standards describe requirements for treatment and redundancy for various end uses. There are four classes of reclaimed water, all of which have the same requirements for TSS and BOD₅ levels (30 mg/L or less for a monthly average), turbidity (less than 2 Nephelometric Turbidity Units [NTU]), and dissolved oxygen (no minimum level required). Each class requires a different level of disinfection and effluent total coliform levels. The classes are described in Table 5.

TABLE 5
Classes of Reclaimed Water and End Users

Class of Reclaimed Water	Treatment Required	Total Coliform Permitted (MPN/100 mL)	End User for Irrigation Purposes
Class A	Oxidation	< 2.2	Irrigation of food crops
	Coagulation		Irrigation of nonfood crops
	Filtration		Open access areas (e.g., public parks)
	Disinfection		
Class B	Oxidation	< 2.2	Irrigation of food crops as long as there is no contact between the edible portion of the crop and the irrigation water
	Disinfection		Irrigation of nonfood crops
Class C	Oxidation	< 23	Irrigation of nonfood crops
	Disinfection		
Class D	Oxidation	< 240	Irrigation of nonfood crops except sod, ornamental plants, and pasture for milking cows or goats
	Disinfection		

Class A reclaimed water is the type of water that Brightwater would produce for reuse. Effluent standards for Class A reclaimed water are listed in Table 6.

TABLE 6
Effluent Standards For Class A Reclaimed Water

Parameter	Optional Urban Landscape Irrigation ^a (Class A)
BOD ₅ (mg/L)	< 30
TSS (mg/L)	≤ 10
Turbidity (NTU)	2
TKN as N (mg/L)	45
NH ₃ -N as N (mg/L)	30
Total Phosphorus as P (mg/L)	8
Average Monthly Fecal Coliform Bacteria Count (MPN/100 mL)	≤ 2.2 ^b

^a Source: Health/Ecology, 1997

^b For total coliform

4 TREATMENT PROCESSES

The treatment processes proposed for each site are similar, with minor differences to accommodate site characteristics. In the Draft EIS, a full flow conventional activated sludge (CAS) process was considered. In comparing alternatives for secondary treatment, it was recognized that the MBR process would produce better effluent quality, benefiting the environment through a substantially lower discharge of pollutants to Puget Sound. However, the MBR technology is more expensive than CAS on a unit flow basis. Configuring an MBR to accept peak flows and loads would render it infeasible due to high cost. Therefore, the concept of a split-flow MBR system was developed, in which the MBR process would be configured to accommodate a daily flow in excess of the AWWF but below the peak flows. The maximum capacity that could be treated by the MBR is termed the secondary treatment, or split-stream, threshold. Flows in excess of the secondary treatment threshold constitute a split stream that would be routed around the MBR. The split stream would be treated using an alternative process better suited to hydraulic peaks, such as ballasted sedimentation. The split stream would be blended with the MBR effluent and disinfected prior to discharge.

This concept, called split-flow treatment, allows MBR technology to be applied to Brightwater, reducing the annual discharge of pollutants by 75 percent or more compared to a full-flow CAS process. Split-flow treatment offers further benefits such as producing a high-quality effluent that meets Class A reclaimed water requirement once it receives additional disinfection. A comparison of effluent quality for MBR and CAS is shown in Table 7. The MBR process would also occupy less land than CAS, thereby increasing the area available for mitigation and environmental enhancement.

TABLE 7
Effluent Quality for CAS and MBR

	MBR Process	Full Flow CAS Process
BOD ₅ (mg/L)	2	20
TSS (mg/L)	2	20
NH ₃ -N as N (mg/L)	< 1.0	19
Phase 1 (2010)		
Annual Discharge BOD ₅	219,000 lbs	2,200,000 lbs
Annual Discharge TSS	219,000 lbs	2,200,000 lbs
Phase 2 (2040)		
Annual Discharge BOD ₅	328,500 lbs	3,300,000 lbs
Annual Discharge TSS	328,500 lbs	3,300,000 lbs

Specific design criteria for each process unit are provided in Attachment B.

4.1 Liquid Treatment Process Summary

All flow would enter the plant through an influent pump station and receive preliminary treatment at the headworks area through screening, followed by aerated or vortex grit removal. Following preliminary treatment, the flow would enter a flow split structure that would direct flows up to the split-stream threshold to the MBR process; flows in excess of the threshold would be directed to the ballasted sedimentation process. An average of 25 split-flow events is anticipated annually. All flow would be disinfected and discharged to Puget Sound through a deep-water outfall.

4.1.1 Influent Pump Station

The purpose of the influent pumping is to transfer sewage from the influent conveyance system to the headworks facility and provide sufficient head for the wastewater to flow through all subsequent treatment processes with no intermediate pump station. Due to the deep tunnel, the influent pump station vertical lift is approximately 200 feet at Route 9 and 125 feet at Unocal. The pump station is in two stages at Route 9 and a single stage at Unocal. For Brightwater buildout with peak flow of 170 mgd, this would require ten pumps at 34 mgd each (plus two standby) at Route 9 and five pumps at 34 mgd each (plus one standby) at Unocal. State regulations require a minimum of one standby unit for peak flow for major new pumping stations. The pump station, downstream plant components, effluent transfer system, and outfall would be sized with sufficient hydraulic capacity to carry the peak-hour flow of 170 mgd. In addition, sufficient electrical power would be provided from two independent sources for reliability.

The influent pump station would have a 100- to 110-foot-inside-diameter shaft/caisson with a wet well at the bottom. The wet well would collect the raw sewage from the conveyance system. An adjacent dry well would have space available for the influent pumps and ancillary equipment. A pump station building would be located at the ground surface on top of the shaft. Elevators and stairs would connect the building to the wet and dry wells. Bridge cranes would be provided to remove equipment for maintenance and to remove trash from the wet well. The building would also contain restrooms, motor

control centers, and access space for loading the pumps on a truck for removal from the site. Process air would be collected from the wet well and shaft and treated for odor control.

4.1.2 Preliminary Treatment (Headworks)

Preliminary treatment removes large objects that typically are not removed in the treatment process and that would cause maintenance problems in downstream unit processes. The equipment includes mechanically cleaned screens for removal of debris and vortex or aerated grit facilities for removal of sand, gravel, and other inorganic matter contained in the wastewater. Both screening and grit removal processes would have airtight covers and would be under negative pressure to control odors. The screens would be housed in a headworks building for odor control. The headworks building would have two floors and an enclosed two-bay truck loading area. Both the building and truck loading area would be under negative pressure to capture and treat odors.

4.1.3 Primary Treatment

The purpose of primary treatment is to remove the settleable portion of the suspended solids in the wastewater. The conventional primary clarifiers and MBR system would be designed to handle flows up to the nominal split-stream threshold (38 mgd for Phase 1) and diurnal peaks up to 1.5 times the nominal threshold (57 mgd for Phase 1). Flows above the threshold would be split off downstream from grit removal and would receive enhanced primary treatment in a ballasted sedimentation system. Ballasted sedimentation consists of a high-rate clarifier that uses chemicals as a coagulant and sand for weight (ballast) to achieve higher solids and BOD₅ removal rates than conventional primary clarifiers. At Route 9, the ballasted effluent would be blended with the secondary effluent prior to disinfection. At Unocal, the ballasted effluent would be blended after disinfection but prior to discharge. The combined effluent would meet secondary effluent discharge permit requirements for concentrations, mass loadings, and percent removal.

The conventional primary system would consist of rectangular primary clarifier units equipped with sludge and scum collection systems. Influent would be distributed to the clarifiers via channels or pipes. Primary effluent would be collected via weirs or pipes and flow to secondary treatment. A longitudinal gallery would be situated between clarifiers, and transverse galleries would be situated at both the influent and effluent ends of the clarifiers to house the primary sludge pumping and piping systems. The primary clarifiers would be covered and under negative pressure to capture process air for treatment in an odor control system.

The ballasted sedimentation system would consist of parallel units that each have three sections: the injection tank where sand and coagulant are added, the maturation tank where coagulation occurs, and the settling tank where high-rate settling on inclined plate settlers takes place. The sand is recovered from the settled solids and reused. The ballasted sedimentation tanks would be covered and under negative pressure to capture process air for treatment in an odor control system.

4.1.4 Secondary Treatment

The purpose of secondary treatment is to remove soluble and fine suspended material that is not removed at the headworks or primary treatment. Flows below the split-stream

threshold from the conventional primary clarifiers would receive biological treatment in the MBR process. The MBR process includes fine screens, aeration basins (which act as bioreactors), and membrane tanks (which separate the liquids from the solids). The fine screens remove remaining debris and inorganic material larger than 2 millimeters (mm) from the wastewater. This is important to maintain the integrity of the membranes.

Air is used in the aeration basins to promote growth of bacteria that convert carbonaceous organic matter into microorganism cell mass. The microorganisms consume the organic matter in the wastewater, thereby creating a more stable wastewater, or wastewater that has less organic matter that can decompose. This process is called activated sludge, and the wastewater in the aeration basins is called mixed liquor.

MBRs separate the solids from the effluent by passing the wastewater through a membrane via a vacuum pump (permeate pump) or gravity. A membrane is a type of filter with pores that only allow passage of a certain particle size. The liquid passes through, and the solids remain in the mixed liquor. The type of membrane system that would be used (gravity or pump) will be decided during Phase 1 predesign. The membranes would be maintained by means of routine, automated scouring to remove solids and by periodic in situ chemical cleaning. Typical cleaning regimens vary by manufacturer and may involve air scouring, membrane relaxation, membrane backpulsing with permeate, membrane backpulsing with chemicals, and/or chemical immersion. Typical chemicals used for cleaning are acids or sodium hypochlorite.

The plant layout was developed to include space for future conversion of the MBR process to a full-flow CAS process. Although evaluations have indicated inherent advantages to an MBR system, it is a relatively new technology with limited operational experience and no facilities are currently in operation in this size range and application. Thus it is prudent to reserve space onsite to convert the MBR system to a CAS system with secondary clarifiers if desired in the future. The secondary clarifiers would provide final sedimentation of the solids from the aeration basin mixed liquor.

4.1.5 Disinfection for Puget Sound Discharge

The purpose of disinfection is to kill remaining pathogens in the plant effluent to a level that complies with the effluent discharge permit. At Route 9, the effluent from the MBRs would be blended with the effluent from the ballasted sedimentation prior to disinfection with sodium hypochlorite. Contact for the disinfection would occur during travel through the effluent tunnel, so no contact chamber would be required onsite. Dechlorination using sodium bisulfite would occur at Portal 5 or Portal 26 between the treatment plant and Puget Sound.

At Unocal, ultraviolet light (UV) would be used to disinfect the MBR effluent. This is because the onsite space for chemical disinfection is limited. The UV disinfection chamber would be a covered channel, with an electrical room adjacent. Because of the variable solids content, sodium hypochlorite would be used to disinfect the ballasted effluent. The effluent from the MBRs would be blended with the ballasted effluent after disinfection and prior to discharge to Puget Sound. The disinfection process tanks would be covered and the process air vented to the secondary odor control system.

Three possible disinfection options were evaluated for process advantages and disadvantages, sizing of components, and order-of-magnitude cost estimates. These three alternatives were delivered sodium hypochlorite, onsite generation of sodium hypochlorite, and UV light (high intensity, both low and medium pressure). Additional information on this evaluation can be found in Appendix 3-K, Treatment Plant Disinfection Alternatives.

4.1.6 Effluent Reuse

Effluent treatment facilities would be provided to produce Class A reclaimed water for reuse. Initially, a 5-mgd reuse facility would be provided in Phase 1. Space would be reserved onsite for additional water reclamation (reuse) facilities up to the AWWF projected for buildout (54 mgd).

The effluent from the MBRs meets the TSS, BOD₅, and turbidity requirements for Class A reclaimed water. The only additional process required is disinfection. To meet the more stringent total coliform limit that is required, disinfection must be at a higher dose than that required for secondary effluent. UV disinfection would be used for the reuse system at both sites. Some sodium hypochlorite may be added in the distribution system to prevent biofouling of the system. If a CAS treatment process is used in the future, the UV disinfection would still be able to provide Class A reclaimed water.

The reuse water would be used onsite for irrigation, tank cleaning, and other processes that do not require potable water, and may be distributed offsite. An onsite reuse pump station would pump the water to the distribution system. The reuse process tanks would be covered and the process air vented to the secondary odor control system.

4.1.7 Effluent Discharge

At Unocal, an effluent pump station would be required to pump the effluent to Puget Sound for discharge. The pumps would be a single-stage system. At Route 9, the outfall and diffuser system would be the same as at Unocal, but plant effluent would flow by gravity from the site to Puget Sound. Due to the elevation of the site, no pump station would be required. The outfall location for Route 9 is off Point Wells in Richmond Beach; for Unocal, the outfall is situated off Point Edwards in Edmonds. More detail on the outfall and diffuser system can be found in Appendices 3-B (Project Description: Conveyance) and 3-C (Project Description: Outfall).

4.2 Solids Processing and Biosolids Management

Solids handling consists of thickening primary and secondary sludge, followed by anaerobic digestion and dewatering. The thickening process removes water from the sludge prior to anaerobic digestion and reduces the downstream treatment and equipment requirements. Anaerobic digestion stabilizes the sludge by converting the organic matter to methane gas and carbon dioxide. Dewatering mechanically removes water from the digested biosolids prior to hauling. Reducing the water content reduces the cost of transporting the biosolids cake (i.e., fewer loads), as well as the size and amount of equipment.

4.2.1 Thickening and Dewatering

Solids would be thickened using gravity belt thickeners (GBTs) and dewatered using centrifuges. The thickening and dewatering equipment, as well as auxiliary storage, pumping equipment, polymer addition system, and odor control system, would be contained in a three-story solids handling building.

4.2.2 Digestion

Thickened sludge would receive a minimum of Class B stabilization through mesophilic anaerobic digestion in multiple cylindrical tanks. However, the digester complex would be configured so that it can be upgraded to a Class A thermophilic-mesophilic anaerobic digestion process in the future. This would give King County the site flexibility to add Class A facilities at a later date.

4.2.3 Biosolids

After digestion, biosolids would be pumped to high-solids centrifuges for dewatering. An enclosed truck bay would be provided for loading the dewatered biosolids into hauling vehicles.

The stabilized, dewatered biosolids would be hauled offsite and beneficially used along with biosolids from the West Point and South Treatment Plants. King County manages biosolids through land application to agriculture and silviculture and by processing biosolids into a compost product. It is anticipated that the majority of the biosolids would be managed by land application, with composting providing an alternative means of biosolids management during periods of extended inclement weather, or when market conditions dictate.

Space would be reserved onsite to allow staging of up to eight biosolids trucks, two in the loading bays and six in an onsite staging area. The trucks would have provisions for odor control. Flexible hose would be used to connect the trucks parked in the staging area to a carbon system prior to the trucks leaving the site. Foul air from the truck beds would be ventilated and treated by the carbon system prior to discharge.

4.2.4 Management of Other Residual Solids

Residual solids produced in screening and grit removal processes would be disposed of in a landfill. Screenings would be removed at one or two locations (headworks and possibly the fine screenings building) and grit from one location (headworks). The screenings from the fine screening facility that is upstream of the MBR process may be combined with the coarse screenings in the headworks to reduce the number of loading areas. The screenings and grit would be hauled away by truck for disposal in a landfill. In either case, screenings and grit would be loaded in enclosed loading areas under negative pressure for odor control.

King County currently recycles grit from the South Plant by hauling it to a private company, where it is dried and mixed into a biosolids compost. King County is actively pursuing recycling options for all its grit. The grit from the Brightwater plant may be recycled if possible.

4.3 Odor Control

To remove odors, the covered process units, enclosed buildings, and loading areas would be under negative pressure to capture odorous process air to be treated by the odor control systems. All process units would be covered, including the influent wet well, screenings and grit handling, primary clarifiers, aeration basins and membrane tanks, and disinfection. Buildings such as headworks and solids handling (thickening and dewatering processes) would have the process air and equipment fully enclosed. There would be five separate odor control systems:

- Influent pump station
- Headworks and primary treatment
- Secondary treatment and disinfection
- Solids handling building and biosolids truck staging
- Digester gas pressure relief emergency vents (carbon only)

Each odor control system would treat the process air using multistage chemical scrubbers followed by a final polishing stage of carbon adsorption. Each stage treats the process air to a greater degree. The exhaust air from the carbon polishers would be discharged from stacks. In addition to the chemical scrubbers, carbon scrubbers would treat any digester gas that may be discharged through pressure release vents.

4.4 Non-Process and Auxiliary Facilities

4.4.1 Administration Building

The administration building is anticipated to be a two-story structure housing the administrative offices, laboratory, conference room, operations and process control center, restrooms, lockers, visitor reception area, lunchroom, archive and equipment storage areas, document production facilities, and a library.

The laboratory would include bench space, fume hoods, refrigerators, scales, sinks, emergency eyewash and shower, ovens, and equipment for sample storage and routine sample analysis. It is intended that the laboratory be equipped and staffed to perform analyses required for routine process control and monthly discharge monitoring reports as required under the plant's National Pollutant Discharge Elimination System (NPDES) permit. Special testing, such as periodic analyses of biosolids metals and effluent priority pollutants, would be performed offsite at the King County Wastewater Treatment Division Water Quality Laboratory.

The operations and process control center would be the main location from which operations staff would monitor and control the treatment processes via the plant supervisory control and data acquisition (SCADA) system.

4.4.2 Maintenance Building

The maintenance building would be a facility for making repairs that cannot be made on in-place equipment. It is anticipated to be a one to two-story structure that houses a machine shop and repair facilities, spare parts storage, and maintenance staff offices. The building is anticipated to have drive-in truck maintenance bays to facilitate loading and unloading of equipment.

4.4.3 Community-Oriented Building

A community-oriented building may be provided as an element of mitigation to enhance public awareness and understanding of environmental issues, to convey the full aspects of the natural water and wastewater cycles through education programs for school groups, and to provide meeting and event space for community members. At the Route 9 site, the community-oriented building would have two stories (approximately 10,000 to 20,000 square feet) accommodating a large meeting room, several smaller classrooms, an exhibit lobby, an artist space, a theater, and administrative and support services. An estimated eight buses per day would be used to transport groups to and from the community-oriented building.

Mitigation measures similar in nature to the community-oriented building at the Route 9 site would be provided at the Unocal site.

4.4.4 Chemical Building

The chemical building would be used to store and distribute chemicals for odor control, ballasted sedimentation, and disinfection. Odor control chemicals would include sodium hypochlorite, sodium hydroxide, and potentially sulfuric acid. Ballasted sedimentation chemicals would include iron salts (ferric chloride) or alum. Sodium hypochlorite would be used for effluent disinfection and prechlorination of the influent. Polymer would be used for thickening and dewatering. Chemicals would be delivered by truck and stored onsite in bulk storage tanks. Polymer may be delivered in bulk liquid or dry form, diluted into solution onsite, and stored in the solids handling building.

All chemical storage and handling would be designed to comply with the applicable local, state, and federal regulations, such as the Uniform Fire Code (UFC), Resource Conservation and Recovery Act (RCRA), and Occupational Safety and Health Act (OSHA). Most of the chemicals would be delivered and stored onsite in solution form. For example, the sodium hypochlorite would be delivered in 12.5 percent solution. The sodium hydroxide solution and the sulfuric acid solution would have strengths of 50 percent and 98 percent, respectively. The onsite storage would provide approximately 15 days storage capacity for each chemical. The dry polymers would be delivered in bags and stored in bags, tanks, or bins. Bags would be stored in a cool, dry location above floor level to allow for easy, safe access and provide dust control and effective cleanup. The tanks and bins would be designed with high- and low-level indicators to allow continuous feed; tanks and bins would have containment and safety provisions in accordance with all applicable requirements. The chemical building would be provided with appropriate ventilation and alarm systems in case of emergency.

The estimates of chemical usage and delivery truck trips are provided in Attachment J.

4.5 Energy Consumption and Generation

Energy requirements were estimated on the basis of current energy use at the West Point and South Treatment Plants. These estimates were refined using assumptions regarding conservation and efficiency measures that would be incorporated into the design to meet energy code requirements and comply with King County energy efficiency and green building initiatives and policies. The energy consumed during plant operation would be for both process (treatment equipment) and non-process (e.g., building lighting,

ventilation, heating) usage. The projected connected load and average annual energy consumption at both sites is shown in Table 8. See Attachment G for details on the energy consumption calculations.

TABLE 8
Estimated Energy Demand and Energy Consumption

	Route 9		Unocal		
	At 36 mgd	At 54 mgd	At 36 mgd	At 54 mgd	At 72 mgd
Average annual energy consumption (megawatts per hour, MW/h)	46,000 – 67,000	79,000 – 114,000	47,000 – 67,000	79,000 – 114,000	96,000 – 138,000
Average connected energy load (megawatts, MW)	7.7	13.2	7.9	13.3	16.1
Cogeneration capacity (MW)	7 – 8	12 – 13	7 – 8	12 – 13	15 – 16
Average annual load served by biogas (MW)	0.7	1	0.7	1	1.4
Average annual load served by natural gas (MW)	7.0	12.2	7.2	12.3	14.7
Diesel generator capacity (MW) for essential loads only	0.25	0.50	0.25	0.50	0.50

A cogeneration facility would be located at the plant site to provide capacity for average annual consumption of 7 to 8 MW in Phase 1. It would contain gas turbines, reciprocating engines, and/or fuel cells that would provide electrical power using biogas (gas produced in the anaerobic digestion process; consists of mostly methane and carbon dioxide) and natural gas as the fuel source. The facility would provide sufficient power to run the entire treatment facility at AWWF capacity, including the influent pump station. The estimate of energy recovery provided by biogas is included in Attachment H.

At the Route 9 site, natural gas for cogeneration would be provided by Puget Sound Energy (PSE) in one of two ways: either via the 6-inch medium-pressure natural gas line that currently supplies the site; or via 3 miles of a new 6-inch high-pressure line to be laid to the site from 20700 39th Avenue SE. At the Unocal site, natural gas would be provided in one of two ways: either via 0.5 mile of new 4-inch-diameter gas line that ties into the existing 4-inch line along Third Avenue South and Dayton Street; or via 3.5 miles of a new 6-inch-diameter high-pressure line from 72nd Avenue West and 212th Street SW to the plant site.

One standby diesel generator of approximately 250 kW output would be provided in Phase 1 for backup power to serve essential life and safety needs, including critical lighting and ventilation, and to start the cogeneration turbines. Approximately 1,000 gallons of diesel fuel would be stored at the vehicle fueling station onsite to provide 48 hours of operation in Phase 1. For Phase 2 (54 mgd), a 500-kW generator would be provided with 2,000 gallons of diesel fuel storage.

4.5.1 Dual-Feed Electrical Service

In addition to the energy generation capacity described above, a dual-feed electrical service would be provided for redundancy and reliability.

Route 9 Site

For Route 9, Snohomish Public Utilities Division (PUD) would supply electrical energy to the site from its Bonneville Power Authority (BPA) SNO-KING substation. The service would come via two independent 115-kV electrical feeders, one new feeder along SR-9 and one existing along 228th Street SE. A dual high-voltage substation would be located on the Route 9 site to step down the voltage to 15 kV for distribution to the plant substation. The plant substation would further reduce the voltage for use throughout the plant. Both substations would have dual feeds and automatic switch gear to provide continuous electrical power in event of failure of one of the feeders. The BPA SNO-KING substation is a major dual-fed substation with primary power feeds from BPA and auxiliary feeds from Seattle City Light and PSE. This substation is the major electrical substation in Snohomish County. It is considered extremely reliable and, coupled with the two independent high-voltage feeders to the plant, would provide adequate redundancy to meet permit requirements for reliability.

Unocal Site

For Unocal, Snohomish PUD would supply two new, independent 115-kV electrical feeders that also originate from the BPA SNO-KING substation. In this case, approximately 4 miles of 115-kV transmission line would be necessary to bring in adequate primary and backup power from the two nearest substations, Richmond Park and Westgate, both approximately 2 miles away. In addition, a 15-kV substation would be provided onsite to step down the transmission line voltage to the voltage used throughout the plant.

4.6 Auxiliary Facilities

Additional auxiliary facilities would be located onsite, including a storage area for large parts and plant maintenance vehicles and a laydown area for construction staging. The storage area for large parts and plant maintenance vehicles would be a carport-type facility with room for six vehicles. In addition, there would be a fueling station for diesel-powered trucks. Diesel fuel would be stored in an above-grade storage tank with a capacity of 1,000 gallons. This would also provide the fuel for the standby diesel generator.

5 HANDLING EMERGENCY OVERFLOWS

Standby power and redundant equipment would be provided to ensure reliable operation during power outages and equipment failure. Influent flow conveyance strategies are also needed to manage inflows to the plant during periods of extreme rainfall so that treatment capacities are not exceeded.

One goal of Brightwater is to add capacity and flexibility to prevent the wastewater overflows that would occur in the existing system north of Lake Washington and the Sammamish River if Brightwater were not built. Implementation of this project would

minimize such overflows, thereby greatly reducing the potential for adverse impacts on water quality in adjacent surface waters.

Emergency wastewater overflows could occur if multiple equipment and power failures occurred during a storm-influenced flow that exceeded the treatment plant or conveyance system capacities. This would be a very rare event resulting from extreme conditions, but it must be planned for and designed into the system. To ensure that public health and environmental quality are protected, King County has developed a five-part emergency flow management system for both the Unocal and Route 9 sites: (1) diverting flows to the West Point and South Treatment Plants, (2) diverting excess flows into the existing Logboom and North Creek Storage Facilities, (3) storing flows in new and existing conveyance pipelines, (4) using emergency generators to keep new and existing pumping stations operational in the event of serious power outages, and (5) diverting partially treated wastewater through the effluent system and/or outfall to Puget Sound. More information on these influent flow conveyance strategies can be found in Appendix 3-E, Flow Management and Safety Relief Point.

As a last resort, for both the Route 9 and Unocal sites, a safety relief point would be situated in the Kenmore area, at or near the junction between the influent tunnel and the low point of the existing conveyance system. Wastewater from the safety relief point would discharge into the lower Sammamish River just before the river discharges into Lake Washington. Discharge from the safety relief point would be extremely rare, the result of catastrophic events beyond those expected during normal year-round operations through the year 2050. Additional information on the safety relief can be found in Appendices 3-B (Project Description: Conveyance) and 3-C (Project Description: Outfall).

No additional safety relief would be provided on the Route 9 site due to elevation of the site and the deep influent tunnel. However, safety relief is required for the Unocal site because the remote possibility exists for the plant to fail while the conveyance system pump station is still delivering flow. To protect against this event, a safety relief system would be designed to discharge influent wastewater to Puget Sound via a bypass from the influent pump station wet well to the plant's effluent outfall. The elevation of the influent pump station and the hydraulic grade line of the flow coming from Kenmore are sufficient to allow discharge to the main outfall with no pump station. The bypass from the wet well would be equipped with a gate that would open automatically if the influent pumps or effluent pumps fail.

6 LAYOUT DESCRIPTION

Buildings and equipment at either site would be arranged to facilitate the treatment process flow. Overall site layout, however, would differ substantially because of the differences in the location, topography, soils, size, and shape of the sites.

Both plant layouts were developed to include space for future expansion to 54 mgd AWWF. Space is also provided to convert the MBR system to a conventional activated sludge system with secondary clarifiers, if desired in the future. Additional space has been reserved if King County elects to produce Class A biosolids.

The plant layouts are shown in Attachment C, and the plant sections in Attachment D. A process schematic for the recommended treatment system is presented in Attachment E.

7 ROUTE 9 TREATMENT PLANT FEATURES

7.1 Site Location and Characteristics

The Route 9 site lies inland, approximately 12.5 miles east of Puget Sound. It is situated in unincorporated Snohomish County east of SR-9, just north of the City of Woodinville and near the intersection of SR-9 and SR-522. The site consists of parcels owned by various individuals, businesses, and organizations. Low-density, single-family residences occupy most of the area surrounding the site, except to the southwest where light industrial businesses are situated.

The site is rectangular in shape and 114.3 acres in total size. The northern portion (37.3 acres), which is outside the Urban Growth Area (UGA), is largely undeveloped, partly forested, and has some wetlands. This area north of the UGA would not be used for construction of treatment facilities. The central and southern portions of the site have been developed for commercial and industrial land uses.

The Route 9 site slopes moderately (less than 10 percent) to the southwest. The elevation of the portion planned for treatment facilities ranges from a low of 150 feet on the west side to a high of 225 feet along part of the eastern property line. Portions of the site along the eastern edge and outside the area planned for treatment plant use slope at 10 to 30 percent. Little Bear Creek lies west of the site and west of SR-9. Several small watercourses flow across the site from east to west in pipes and open ditches. In addition, two streams traverse the site. One in the north, which has no name (called "Unnamed Creek" in this EIS), originates northeast of the Route 9 site, traverses the northern portion of the site in a southwest direction, and discharges into Little Bear Creek. The other, called Howell Creek, is in the southern part of the site and also discharges into Little Bear Creek.

Site soil and groundwater may be currently contaminated as the result of past and current industrial uses. One property on the site is on Ecology's Model Toxics Control Act (MTCA) list of suspected and confirmed contamination sites as of May 2001. It has been ranked as a 5, the lowest level of risk, and it is awaiting remedial action. For purposes of this EIS, it is assumed that some soil and groundwater contamination would be encountered during the large-scale excavation required for construction of the Brightwater plant. Additional investigations would be conducted to confirm the type and extent of contamination present and the method of remediation.

Part of the Route 9 site lies over the southern boundary of the Cross Valley Sole Source Aquifer (CVSSA). A sole-source aquifer is one that supplies 50 percent or more of the drinking water for an area and for which contamination would pose a significant hazard to public health. Groundwater from the CVSSA is provided to users by the Cross Valley Water District (CVWD). The CVWD supplies water to over 5,400 connections in unincorporated Snohomish county, including residents, businesses, and public schools in the vicinity of the Route 9 site. The Route 9 site is within the CVWD service area, and water demand from customers at the site (including the StockPot Culinary Campus) was 40 gallons per minute (gpm) from July 1, 2001, to June 30, 2002. Approximately

89 percent of the water is from groundwater sources. The CVWD is required to establish wellhead protection measures for recharge areas to minimize threats to the water supply from potential contaminants. However, the Route 9 site is entirely outside the CVWD's wellhead protection area and is in the discharge zone of the CVSSA. This means that water under the site is moving out of, rather than into, the aquifer.

7.2 Site Layout

A preliminary site plan has been prepared for the Route 9 site to show the location and arrangement of the major treatment and support facilities (Attachment C). The site plan includes influent pumping; preliminary, primary, and secondary treatment; disinfection; and water treatment for reuse; solids treatment and handling; odor control; and electrical substations. Support facilities include administration, maintenance, and chemical storage buildings. The total footprint of the treatment and support facilities would be approximately 43.0 acres (excluding stormwater facilities), with an additional 4.0 acres reserved for expansion to full-flow CAS and Class A biosolids. The treatment plant and the stormwater management facilities would occupy 80.6 acres. See Attachment F for plant site areas.

The wastewater treatment facilities would be in the central and southern parts of the site. The administration and maintenance buildings would be in the southern portion of the treatment facilities, close to the influent and solids handling system, which generally requires the most operation and maintenance attention. The liquid treatment facilities would be on the eastern side of the site, arranged from south to north based on process flow sequence. The water reuse facilities would be at the northern end of the site. The solids treatment and handling units would be in the southern part of the site near preliminary and primary treatment. Odor control facilities are decentralized and located near their respective process units: influent pump station, preliminary and primary treatment, secondary treatment, and solids handling.

The primary vehicle access to the site would be from the intersection of SR-9 and 228th Street SE, which has a traffic light. Secondary access would be provided near the south end of the property.

Stormwater generated at the site would be managed at the site. Emphasis has been placed on minimizing the amount of stormwater generated. The basic site concept minimizes stormwater generation by restoring a large portion of the site to forest. This measure would mimic the natural hydrologic processes of much of the site in its pre-developed condition. This forested area may also be used to disperse some of the stormwater generated by adjacent built areas of the plant. The project would adhere to the guidelines of Ecology's stormwater management manual for Western Washington (Ecology 2001).

The project emphasizes the use of low-impact development (LID) as another basic approach to reduce stormwater runoff. The LID measures that can be applied at the Route 9 site include: open site design, establishment of forested areas, vegetated roofs, porous pavement, bioretention swales, and amended soil. Porous pavement would be used for automobile parking areas, light-use roadways, and sidewalks to promote stormwater infiltration. Vegetated roofs would be used on some of the process and nonprocess buildings. Such roofs are effective in temporarily storing and reducing runoff. Amended

soils would be incorporated into the landscaped areas of the site. The stormwater infiltration and holding capacity of amended soils is greatly enhanced, also reducing runoff.

A canal is a central feature of the Route 9 site concept that would also serve an important stormwater management function. The canal would be oriented north to south across the length of the site. It would be 60 feet wide and approximately 2,800 feet long. The canal would receive and detain clean runoff from roofs, low-maintenance landscaped areas, and other nonpolluting areas of the site. In addition, the canal may receive stormwater runoff that has been treated at other locations onsite. Underground pipes or vaults may be used to provide detention within or immediately adjacent to the built areas of the plant. A series of ponds, constructed wetlands, and bioretention swales would be constructed along the western side. Stormwater from the treatment plant roads, parking areas, and other pollutant generating surfaces would be conveyed to this area for treatment and detention. After treatment and detention, the stormwater would be conveyed to existing culverts under SR-9 and thence into Little Bear Creek. The existing culvert for Howell Creek may require upgrading to achieve the required capacity.

Contaminated runoff could occur at certain process locations, including chemical storage areas, chemical transfer locations, biosolids truck loading areas, and truck parking or maintenance areas. Material removal from the grit chamber at the headworks and the fine screens at the primary clarifiers presents another potential for spillage of contaminated material. The project would be designed to hydraulically isolate the exposed ground surfaces surrounding these areas so that local runoff does not mix with stormwater from other parts of the site. Instead the runoff from these isolated locations would either flow to a designated sump or be routed to the treatment plant, where it would be fully treated and discharged in the effluent line. These comprehensive source control methods would greatly reduce, if not entirely eliminate, the potential that contaminants from the wastewater treatment process could enter the stormwater system.

Additional information on the stormwater system can be found in Appendix 6-D, Permanent Stormwater Management at the Treatment Plant Sites.

7.3 Changes From the Draft EIS

Several areas of the Route 9 layout have been refined following issuance of the Draft EIS, as described below:

- Odor control.** In the Draft EIS, the odor control system was three-stage chemical scrubbers followed by biofilters for polishing. The current system is three-stage chemical scrubbers plus carbon polishing, which is the same as the odor control system at Unocal. The odor control system in the Draft EIS was centralized at Route 9 (all process air routed to one central location for treatment). It is now decentralized (process air treated adjacent to the facility where it originates), the same as Unocal. There are five separate odor control systems: influent pump station, preliminary and primary treatment, secondary treatment, solids handling, and digester pressure release emergency gas vents (carbon only). The decentralized system allows the odor control system design to better accommodate the types of odorous compounds from the specific process being treated (e.g., preliminary and primary

treatment, secondary treatment, solids handling, etc.) as opposed to treating the complex mix of all the odorous compounds at the treatment plant. Decentralizing odor control also provides flexibility for construction. The odor control systems can be contracted by facility (e.g., influent pump station, liquids, solids) as opposed to having all odor control systems as one separate contract and requiring the contractor to coordinate activities with the contractors who are constructing the liquids and solids treatment process facilities.

- **Wastewater flow direction.** The Draft EIS had the influent pump station at the north end of the site, and the wastewater flowed from north to south. Now the influent station would be at the south end of the site, with the wastewater flowing from south to north. This arrangement would allow for a shorter effluent tunnel and would improve public perception of the treatment plant by having the treated (“clean”) water at the northern, more public end of the site. The grading and fill quantities were found to be comparable either way. The cut and fill quantities for the proposed layout are provided in Attachment I.
- **Effluent pump station.** The need for an effluent pump station depends on the profile of the effluent transfer system. It was determined during predesign that an effluent pump station for Route 9 site would not be required. Additional information can be found in Appendices 3-B (Project Description: Conveyance) and 3-C (Project Description: Outfall).
- **StockPot Culinary Campus property.** The Draft EIS excluded the StockPot facility from the plant property. The current layout assumes that StockPot would move offsite and the land can be used for treatment plant facilities.
- **Water resource management.** A centralized system to collect stormwater would include a series of stormwater inlets and piping to collect the runoff and convey it by gravity to collection points, thence from the collection points to the detention and treatment facilities at the western end of the plant. This varies from the Draft EIS layout, which collected the stormwater at the lowest part of the site but pumped it to a higher elevation in the northern part of the site for treatment. After detention and treatment, stormwater would flow through existing culverts under Route 9 and into Little Bear Creek. One or more of these culverts may require reconstruction to achieve the required capacity.
- **Community-oriented building.** The revised layout includes space onsite for an additional building for community and educational uses should the community desire such a facility. This facility was not described or presented in the Draft EIS.

8 UNOCAL TREATMENT PLANT FEATURES

Like the Route 9 alternatives, the plant design proposed for the Unocal site would use the same secondary treatment process to meet discharge requirements and release a disinfected effluent to Puget Sound that meets Washington State standards. Two sub-alternatives, 72 mgd capacity and the structural lid (see Section 1), have also been evaluated for this site.

8.1 Site Location and Characteristics

The 52.6-acre Unocal site is situated on a hillside next to Puget Sound. Treatment facilities would be constructed using a series of retaining walls and terraces. The effluent would discharge through an outfall directly west of the plant into Puget Sound.

Stormwater runoff would go to a water quality pond at the lowest elevation on the west side of the site, where it would be treated and then discharged into Puget Sound. This direct discharge makes detention unnecessary, and none would be provided.

The Unocal site is within the City of Edmonds just southeast of the Port of Edmonds Marina. The site includes area east and west of the Burlington Northern-Santa Fe Railroad tracks and the right-of-way for Pine Street. Pine Street would be relocated to accommodate the plant. A small triangular piece of the site along the shoreline west of the railroad includes a marsh and modified beach area along Puget Sound. The plant would be built on the larger triangular piece of land east of the railroad tracks. Willow Creek and a wetland occupy the eastern perimeter of this larger piece of land, and the railroad runs along its western perimeter. The Deer Creek Hatchery is in the southeast corner. Residences lie to the south and southeast.

The Unocal Corporation owns the portion of the site east of the railroad. The City of Edmonds owns the small portion west of the railroad. Unocal formerly used the southern part of the property as a tank farm for storing, blending, and distributing various petroleum products, including gasoline, diesel fuel, and bunker fuel. The northern part of the site was used for asphalt production between 1953 and the late 1970s. Abandoned oil tanks and underground storage tanks were removed in 2001. A small pier in Puget Sound, connected to the southwest part of the site by pipelines, was used to unload oil from ships to the tank farm. The City of Edmonds property west of the railroad is currently used as public parkland.

The Unocal site has confirmed soil and groundwater contamination originating from 70 years of industrial activity. Unocal is currently conducting investigation and cleanup under an order from Ecology.

The topography of the site rises from north to south and west to east. The wetland areas in the northern part are relatively flat, transitioning to a hillside that slopes steeply to the south and east. The grade of the slope ranges from 0 to 40 percent over the majority of the site, generally the northern and eastern portions, and 40 to 80 percent over the remaining, and generally western, portion of the site.

If the lid is not built, a deep foundation system would be required for the facilities in the lower yard of the Unocal site to resist buoyancy due to high groundwater and provide support in liquefiable soils. A preliminary structural analysis was performed to determine the number of piles and the thickness of the concrete mat foundation required. The conceptual foundation design for the structures in the lower yard is shown in Attachment M.

8.2 Site Layout

A conceptual design for the treatment plant on the Unocal site is shown in Attachment C. The layout includes the 1.6 acres of the Pine Street right-of-way that would be relocated along the south property line. The plant would include preliminary, primary, and

secondary treatment; disinfection; water treatment for reuse; solids treatment and handling; electrical substations; odor control; and influent and effluent pumping facilities. Support facilities include administration and maintenance buildings and chemical storage. The total footprint of the treatment and support facilities would be approximately 34.5 acres for the base alternative. For the 72-mgd sub-alternative, the plant would occupy 34.7 acres, with an additional 6.6 acres reserved for expansion to full-flow CAS and Class A biosolids. The 72-mgd sub-alternative with the structural lid would occupy a footprint of 39.1 acres. See Attachment F for plant site areas.

Between the treatment process units and the southern property line would be a 50- to 75-foot setback to provide a buffer to residents on the south; greater buffers would be provided between treatment facilities and Willow Creek. Because of the steep slopes, a series of retaining walls would be constructed in a stepwise fashion to terrace the site for construction of the treatment units and to allow for reasonable road grades. For example, the preliminary treatment facilities and solids handling facilities would be placed on the 125-foot level; the entrance and administration building would be on the 95-foot level; and the secondary treatment and reuse treatment facilities would be on the lower, northern part of the site. The terraces constructed in the first phase of construction for the 36-mgd treatment plant would provide sufficient room for addition of the individual treatment process units required for the 54-mgd expansion and the 72-mgd sub-alternative. The additional area for the expanded plant would be located in the vicinity of the secondary treatment and reuse facilities.

Edmonds Way (SR-104) is the main road access to the site; it connects to the hillside and lower site area east of the railroad. Pine Street runs along the southern boundary and into the Unocal property. Pine Street would be relocated along the southern property line of the site; details of the relocation are presented in Attachment L.

Stormwater generated at the site would be managed at the site. As with the Route 9 site, emphasis has been placed on minimizing the amount of stormwater generated. All runoff from pollutant-generating surfaces would be conveyed to a water quality pond in the northern part of the site for treatment. Where practical, runoff from nonpolluting surfaces would be routed directly to the stormwater outfall to Puget Sound. Detention would not be required.

8.3 Changes from the Draft EIS

Three areas of the Unocal layout were refined during Phase 1 predesign and are described below:

- **Effluent Disinfection.** The Draft EIS included UV light for disinfecting secondary effluent and water for reuse. Due to the change to a split-flow MBR system, UV light is now proposed only for the MBR portion of the effluent. The split-flow ballasted sedimentation would undergo sodium hypochlorite disinfection. Dechlorination would be located just upstream of the flow blending structure, where MBR effluent would be blended with the disinfected dechlorinated ballasted effluent.
- **Water Reuse.** The water reuse system would use UV for disinfection as in the Draft EIS. All three disinfection systems would be located in the northern part of the plant.

- **Stormwater Discharge.** The wet pond system described in the Draft EIS would remain the same. However, instead of discharging through a nearshore shallow outfall, the treated stormwater would discharge through a new outfall at elevation – 50 feet MLLW. The new outfall would be constructed in the same trench as the marine outfall for plant effluent. Both pipes would be buried to approximate elevation –50, at which point the stormwater pipe would daylight and discharge, and the remainder of the effluent outfall would be laid on the seafloor.

8.4 Sub-Alternatives

8.4.1 *Sub-Alternative: Treat Edmonds and Lynnwood Flows at the Unocal Site*

There are two existing local wastewater treatment plants in or near the City of Edmonds. One plant, operated by the City of Lynnwood, is situated in the far north end of Edmonds. The other plant, operated by the City of Edmonds, is about one-half mile from the Unocal site in downtown Edmonds. King County currently operates under a flow transfer agreement with Edmonds; however, Edmonds and Lynnwood are not part of King County's service area. Treating flows from Edmonds and Lynnwood would require expanding the Brightwater plant to 72 mgd AWWF capacity.

As described above, a regional treatment plant at the Unocal site would be constructed in at least two phases: (1) an initial phase providing capacity to treat up to 36 mgd in 2010 and (2) a later expansion through addition of treatment components in about 2040 to increase the capacity to 54 mgd. Should Edmonds and/or Lynnwood decide either now or later to close their plants and transfer the flows to the Brightwater plant, those transfers could be accommodated by expanding Brightwater. The design of the 72-mgd expansion would have to incorporate the structural lid and its foundation structure. The site layout for the 72-mgd plant is shown in Attachment B. Note that sufficient area is available onsite to expand the plant to 72 mgd capacity using the split-flow MBR treatment process. However if the plant were converted to full-flow CAS, the secondary clarifiers would encroach on the eastern wetlands and Willow Creek.

The outfall at the Unocal site would be sized to convey and discharge the full potential flows, including the Edmonds and Lynnwood flows. Neither city has formally expressed an interest in treating its flow at the Brightwater plant; however, if in the future Edmonds or Lynnwood decides to pursue flow transfer, environmental review would be required to evaluate the effects of installing pipelines to convey the flows to the Brightwater plant. The impacts of a 72-mgd treatment plant at the Unocal site are evaluated in the Final EIS.

8.4.2 *Sub-Alternative: Construct a Structural Lid Over the Treatment Plant at the Unocal Site to Accommodate the Edmonds Crossing Project*

The structural lid sub-alternative for the Unocal site would accommodate the proposed multimodal transportation facility, Edmonds Crossing. The multimodal facility would include ferry access, toll booths, and loading lanes as specified in the Edmonds Crossing proposal (Bernstein/WSA, 1995), with an adjustment of the facility alignment geometry to be oriented along the retaining walls of the treatment plant. In addition, all facilities would be located on the lid with grade-separated access to commuter rail platforms and stations. The multimodal facility would provide parking for 580 spaces, a vehicle dropoff

and pickup area along the western edge of the lid, and transit lanes and loading berths at ferry and commuter rail linkage points. The lid sub-alternative would also provide pedestrian access to neighboring roads, the hatchery, and the treatment facility.

The decision to include a multimodal lid would need to be made before commencement of final design of the treatment plant so that the design and construction of the lid and treatment facilities could be coordinated.

Preliminary site layouts for both the 54-mgd and 72-mgd facilities are shown with the multimodal lid in Attachment C. The lid would cover a majority of the secondary processes, including the fine screens, aeration basins, MBR tanks, membrane support building, and the space reserved for CAS secondary clarifiers; maintenance building; reuse facilities; and a portion of the effluent pump station.

Support for the lid would consist of deep piles and support columns, beams, and girders. The spacing for the piles and columns would vary depending on the configuration of the tankage and buildings below the lid. In the areas of rectangular tanks and building, piles and columns would be integrated into walls and footings in a grid pattern to coincide with the tank and building dimensions. In the areas of circular structures, where long spans are required, piles and columns would be independent of the structure and be located around the perimeter of the tankage. Preliminary conceptual foundation and support plans and details are presented in Attachment K.

REFERENCES

- Bernstein, P.E./Wilbur Smith Associates. 1995. *Edmonds Crossing Project Discipline Report*. Prepared for Federal Highway Administration, WSDOT, and City of Edmonds. Prepared by Reid Middleton, Inc., submitted by CH2M HILL, Bellevue, WA. 1995.
- Ecology. 2001. *Stormwater Management Manual for Western Washington*. Washington State Department of Ecology, Lacey, WA.
- Health/Ecology. 1997. *Water Reclamation and Reuse Standards*. Washington State Departments of Health and Ecology.

ATTACHMENTS

- A – Project Description Summary
- B – Design Criteria
- C – Layouts
- D – Sections
- E – Process Flow Schematics
- F – Plant Site Areas
- G – Energy Requirements
- H – Energy Recovery Potential from Biogas
- I – Cut and Fill Quantities
- J – Truck Trips for Plant Operation
- K – Lid Sub-Alternative for the Unocal Site
- L – Pine Street Relocation Evaluation
- M – Unocal Pile Foundation

Attachment A – Project Description Summary Outline

Project Description Summary Outline

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
1.0 General Site Information				
1.1 Location	Inland, in unincorporated Snohomish County, just north of the city of Woodinville	Located on a site near Puget Sound in the City of Edmonds, south of downtown Edmonds, near the Edmonds marina.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
1.2 Geographic setting	Central and southern portions of site are developed for commercial and industrial land uses. Small, older one-story structures and new multistory warehouses and factories occupy portions of the site. Northern portion is outside Urban Growth Area, undeveloped, partly forested, and has wetlands.	Site was a former petroleum products tank farm and asphalt plant. Zoned Master Plan Hillside Mixed Use 1 and 2 (MP1 and MP2).. MP1 provides for uses such as residential, office, restaurant, parks, and local public facilities. MP2 includes all those uses in addition to educational facilities and a multimodal transportation center.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
1.3 Topography	Relatively flat – ground surface slopes to west, draining to Little Bear Creek. Western portion of site slopes gently (10% or less) between elevations of 150 to 170 feet. To the east of the site, ground surface rises steeply toward SR-522, from 220 to 300 feet.	Rises steeply from the shoreline, west to east. On the northwestern edge of the property is an area that is relatively flat. The remainder of the site has moderate to steep slopes (15-40%); site elevation ranges from 10 to 175 feet	Same as Unocal Base Alternative	Same as Unocal Base Alternative
1.4 Proximity to Puget Sound (discharge point)	Approximately 12.5 miles east of Puget Sound	Site is located near Puget Sound directly east of the BNSF railroad	Same as Unocal Base Alternative	Same as Unocal Base Alternative
1.5 Road/street orientation (site access)	Near the intersection of SR-9 and SR-522. Vehicle access to existing site at multiple locations along SR-9; one existing signalized intersection at SR-9 and 228 th Street SE	Near the intersection of Edmonds Way (SR-104) and Pine Street. Vehicle access to existing site from Edmonds Way (SR-104).	Same as Unocal Base Alternative	Same as Unocal Base Alternative
1.6 Local governments with jurisdiction	Snohomish County	City of Edmonds, Snohomish County	Same as Unocal Base Alternative	Same as Unocal Base Alternative

2.0 Site Size and Plant Footprint				
2.1 Total Site:	114.3 acres, including Stockpot Culinary Campus	52.6 acres, including 4.5-acre parcel west of the railroad tracks	Same as Unocal Base Alternative	Same as Unocal Base Alternative
2.1.1 Within Urban Growth Area:	77.0 acres	52.6 acres	Same as Unocal Base Alternative	Same as Unocal Base Alternative
2.1.2 Outside of UGA:	37.3 acres	0 acres	Same as Unocal Base Alternative	Same as Unocal Base Alternative
2.2 Plant footprint				
2.2.1 Total footprint (areas occupied by treatment and support facilities)	43.0 acres for 36 and 54 mgd. 80.6 acres including stormwater management facilities	34.5 acres for 36 and 54 mgd (include stormwater pond)	34.7 acres for 72 mgd	39.1 acres for 72 mgd with multimodal lid (lid occupies 20.1 acres)
2.2.2				
2.2.3 Estimated buffer areas (location and size)	Internal buffer to north = 39 acres, internal buffer to west = 19 acres, internal buffer to southeast = 9 acres. There is an additional buffer to southeast to SR-522 that consists of undeveloped land outside the site, not intended for King County ownership.	Internal buffer to northeast = 13.2 acres, internal buffer to northwest = 2.1 acres, and internal buffer to south = 2.9 acres. There are additional buffers to the northwest and northeast that consist of undeveloped land outside the site, not intended for King County ownership.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
2.2.4 Area of impervious surface	26 acres for 36 mgd for MBR 27 acres for 54 mgd for MBR 29 acres for 54 mgd for CAS and Class A biosolids	22 acres for 36 mgd for MBR 23 acres for 54 mgd for MBR 25 acres for 54 mgd for CAS and Class A biosolids	24 acres (72 mgd) 26 acres (with space reserved for CAS and Class A biosolids)	28 acres (72 mgd) 28 acres (with space reserved for CAS and Class A biosolids)

3.0 Capacity (AWWF and Peak Flows) and Phasing (General)				
3.1 First phase, Online Year 2010			Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
Average annual flow	31 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
Average wet-weather flow	36 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
Split-flow threshold	38 mgd through MBR process; sustained flows above 38 mgd treated in ballasted sedimentation process and blended with MBR effluent prior to discharge	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
Peak-hour flow	130 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
Peak hydraulic capacity (all influent pumps in service)	170 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
3.1.1 Influent pump station	36 mgd AWWF, 130 mgd peak flow	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.2 Preliminary (screening and grit removal)	36 mgd AWWF, 130 mgd peak flow	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.3 Conventional primary treatment	38 mgd with diurnal peak flows of 57 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.4 Ballasted sedimentation treatment	Sustained flows in excess of 38 mgd with peak flows of 92 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.5 Secondary treatment	38 mgd for MBR, with diurnal peak flows of 57 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.6 Disinfection	36 mgd AWWF, 130 mgd peak flow	38 mgd split-flow threshold UV disinfection 92 mgd ballasted sedimentation peak-flow hypochlorite disinfection	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.7 Effluent pump station	Not required	36 mgd AWWF, 130 mgd peak flow	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.8 Solids handling	- For average annual flow, 59,000 lb/day thickened solids to digestion, 30,000 lb/day dewatered biosolids - For peak month flow , 75,000 lb/day thickened solids to digestion, 42,000 lb/day dewatered biosolids	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
3.1.9 Advanced treatment (tertiary) for reuse	5 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Same as Unocal Base Alternative
3.1.10 Reserved space	4 acres is reserved on site to convert the MBR system to full-flow CAS with secondary clarifiers and to convert biosolids digestion to produce Class A biosolids with 1 additional digester and an additional 100’ x 100’ section for the digester building.	4.8 acres is reserved onsite for CAS and Class A similar to Route 9.	6.6 acres is reserved for CAS and Class A	2.2 acres is reserved for CAS and Class A beyond the lid footprint
3.1.11 Onsite cogeneration	7 to 8 mW	Same as Route 9 site	Assume same as Unocal Base Alternative	Same as Unocal Base Alternative
3.2 Second Phase Online Year 2040				
Average annual flow	47 mgd	Same as Route 9 site	62 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
Average wet weather flow	54 mgd	Same as Route 9 site	72 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
Split flow threshold	56 mgd through MBR process; sustained flows above 56 mgd treated in ballasted sedimentation process and blended with MBR effluent prior to discharge	Same as Route 9 site	76 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
Peak hour flow	170 mgd	Same as Route 9 site	235 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
Peak hydraulic capacity (all influent pumps in service)	170 mgd	Same as Route 9 site	235 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.1 Influent pump station	54 mgd AWWF, 170 mgd peak flow	Same as Route 9 site	72 mgd AWWF, 235 mgd peak flow	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.2 Preliminary (screening and grit removal)	54 mgd AWWF, 170 mgd peak flow	Same as Route 9 site	72 mgd AWWF, 235 mgd peak flow	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.3 Conventional primary treatment	56 mgd with diurnal peak flows of 84 mgd	Same as Route 9 site	76 mgd with diurnal peak flows of 114 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.4 Ballasted sedimentation treatment	Sustained flows in excess of 56 mgd with peak flows of 114 mgd	Same as Route 9 site	Sustained flows in excess of 76 mgd, with peak flows of 159 mgd	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.5 Secondary treatment	56 mgd for MBR process, with diurnal peak flows of 84 mgd	Same as Route 9 site	76 mgd for MBR process,	Same as Unocal Base

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
			with diurnal peak flows of 114 mgd	Alternative or 72 mgd Sub-alternative
3.2.6 Disinfection	54 mgd AWWF, 170 mgd peak flow hypochlorite disinfection	56 mgd UV disinfection 114 mgd ballasted sedimentation peak-flow hypochlorite disinfection	76 mgd UV disinfection, 159 mgd peak-flow hypochlorite disinfection	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.7 Effluent pump station	Not required	54 mgd AWWF, 170 mgd peak flow	72 mgd AWWF, 235 mgd peak flow	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.8 Solids handling	<ul style="list-style-type: none"> - For average annual flow, 88,500 lb/day thickened solids to digestion, 45,000 lb/day dewatered biosolids - For peak month flow, 112,500 lb/day thickened solids to digestion, 63,000 lb/day dewatered biosolids 	Same as Route 9 site	<ul style="list-style-type: none"> - For average annual flow, 118,000 lb/day thickened solids to digestion, 60,000 lb/day dewatered biosolids - For peak month flow, 150,000 lb/day thickened solids to digestion, 84,000 lb/day dewatered biosolids 	Same as Unocal Base Alternative or 72 mgd Sub-alternative
3.2.9 Advanced treatment (tertiary) for reuse	- Reuse facilities configured for potential expansion to 54 mgd with space reserved for additional chambers	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
3.2.10 Reserved space	Same as Phase 1	Same as Phase 1	Same as Unocal Base Alternative	Same as Unocal Base Alternative
3.2.11 On-site Cogeneration	12 - 13 mW	Same as Route 9 site	15 – 16 mW	Same as Unocal Base Alternative or 72 mgd Sub-alternative

4.0 Facilities Description				
4.1 Plant layout	See Route 9 site layout for 36 and 54 mgd.	See Unocal site layouts for 36 and 54	See Unocal site layouts for 72 mgd	See Unocal site layouts for 54 and 72 mgd with multimodal lid
4.1.1 Facilities	The wastewater treatment facilities would be generally located in the central and southern portion of the site. Stormwater management and wetland enhancement would occur on the northern, western, and southern portions of the site.	The main wastewater treatment facilities would be located on the majority of the site. The site would be terraced with a series of retaining walls to provide three terraces (at 125’, 95’, and 20’) for the treatment and support facilities; stormwater management would occur along the BNSF railroad in the northwestern portion of the site.	Same as Unocal Base Alternative	A structural “lid” would be constructed over the northern portion of the site that could accommodate a multimodal transportation facility. The multimodal facility would include ferry access roadways; pedestrian access; holding lanes; parking for ferry, bus, and heavy rail commuters; and access to the railroad. The wastewater treatment facilities would be arranged in the same layout as the base alternative. The stormwater facilities could be located in a vault if required.
4.1.2 Buffers	There is a large buffer zone to the north, 450’ from the treatment facilities (not including space reserved for CAS) to the Urban Growth Area, plus the 37.3 acres outside the Urban Growth Area. To the east and south, there would be a minimum setback of 50' from the property line to the facilities, with an additional buffer of undeveloped land between the	A buffer zone extends 50’ feet, minimum, around the facility. The buffers consist of existing wetland and streams, stormwater ponds, and landscaped areas.	The space reserved for the secondary clarifiers extends into the eastern wetlands and buffer zone.	Same as Unocal 72 mgd Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
	property line and shoulder of SR-522. To the west, there is an additional buffer zone from the plant facilities to SR-9. The west buffer area would consist of stormwater management facilities, berms, and forested areas. The east, south, and north buffers would be landscaped and/or forested.			
4.1.3 Access	Primary vehicle access from SR-9 and 228th Street SE; secondary access from an additional driveway off SR-9, near the south end of the site.	Primary vehicle access from Edmonds Way (SR-104) to Pine Street	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.1.4 Stream relocation/ fishpond relocation	The watercourses that run from the east to the west would be collected along the eastern site boundary and routed to the north and south ends of the site. Watercourses 1– 8 would be diverted south to Howell Creek and Channels A & B (228th Street Creek) would be diverted north to Unnamed Creek. There is a salmon rearing pond on the property. It would be upgraded and relocated in the northern portion of the site.	The existing fish hatchery would remain. The existing creeks would remain. An additional mitigation measure would be provided, consistent with the proposed Edmonds Crossing project, to daylight the lower portion of Willow Creek from the northern portion of the treatment plant site to discharge to Puget Sound.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.2 Design life				
4.2.1 Plant facilities	50 to 100 years	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.2.2 Equipment	Membranes have 6-8 year life, all other major equipment 20 years	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3 Liquids Treatment	The liquids treatment facilities would be on the eastern portion of the site, arranged from south to north based on process sequence. The wastewater would flow by gravity through the liquids process once flow is lifted from the influent tunnel by the influent pump station.	The liquid treatment facilities would begin on the top terrace (elevation 125) with preliminary and primary treatment. Secondary treatment would be on the bottom terrace (elevation 20) along with disinfection and the effluent pump station.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.1 Sequence of Facilities	<ul style="list-style-type: none">– Influent pump station– Preliminary treatment (screening and grit removal)– Structure to split flow to either conventional primary clarifiers or ballasted sedimentation– From conventional primary clarifiers to fine screens, aeration basins, MBR separation, and diversion of MBR effluent to reuse disinfection– Structure to blend effluent from ballasted sedimentation and MBR processes for disinfection and discharge to the effluent transfer system– Dechlorination located offsite– Discharge to Puget Sound	<ul style="list-style-type: none">– Influent pump station– Preliminary treatment (screening and grit removal)– Structure to split flow to either conventional primary clarifiers or ballasted sedimentation and sodium hypochlorite disinfection– Fine screens, aeration basins, MBR separation, and diversion of MBR effluent to UV disinfection and reuse disinfection– Structure to blend effluent from disinfected ballasted sedimentation and disinfected MBR effluent for discharge– Discharge to Puget Sound	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.2 Influent pump station	The influent pump station pumps the raw wastewater from the deep influent tunnel up to the preliminary treatment facility (headworks). The influent pump station would be located inside and above the shaft that connects to the influent tunnel. Two wet wells at the bottom of the shaft would receive the influent flow, and two dry wells near the bottom would house the pumps. The motors and associated equipment would be located on multiple floors above the wet wells and dry wells. Vertical chambers would be provided within the shaft structure to contain the hydraulic surge in the event of complete power or pump failure. Odor control would be provided for the pump station wet well and portion of the influent tunnel.	The influent pump station pumps the raw wastewater from the tunnel force main up to the preliminary treatment facility (headworks). The influent pump station would be located inside and above the shaft that connects to the influent tunnel. Two wet wells at the bottom of the shaft would receive the influent flow, and one dry well near the bottom would house the pumps. Bypass would be provided to the effluent pump station wet well in the event of complete power or pump failure. Odor control would be provided for the pump station wet well and portion of the influent tunnel.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.2.1 Location and rationale	In the southern portion of the campus, just west of solids handling and in close proximity to the preliminary treatment (headworks) facility.	In the western corner of the site, in close proximity to the preliminary treatment (headworks) facility	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.2.2 Dimensions	Facility – 130’ x 130’ x 20’ in height above finish grade and on top of a 110 ‘-internal-diameter shaft approximately 260’ below ground	Same as Route 9 site except shaft approximately 125’ below ground	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.3 Preliminary Treatment				
4.3.3.1 Description of process units	Preliminary treatment removes large objects that typically are not removed in the treatment process and cause maintenance problems in downstream unit processes. The equipment includes mechanically cleaned screens for removal of rags, sticks, and other debris and grit chambers to remove sand, gravel, and other inorganic matter contained in the wastewater. The screens and grit removal tanks and equipment would be housed in a headworks building for containment of odors. The headworks building would be a two-story building with a two-bay truck drive through-loading area for removal of screenings	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
	and grit offsite to a land fill for disposal.			
4.3.3.2 Location	Southwestern portion of the campus close to the influent pump station.	Southwestern corner of facility on the upper terrace.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.3.3 Dimensions	Headworks building – 130’ x 92’ x 50’ in height above finish grade Flow split structure following headworks building – 15’ x 12’ x 10’ sidewater depth	Same as Route 9	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.4 Primary Treatment				
4.3.4.1 Description of process units	<p>Conventional primary system for flows up to the split-flow threshold would consist of rectangular primary clarifier units equipped with sludge and scum collection systems. Upstream of the clarifiers would be a full-width influent distribution channel. The primary effluent would be collected downstream of the clarifiers in an effluent collection channel. A longitudinal gallery would be located between clarifiers, and a transverse gallery would be located at the influent and effluent ends of the clarifiers. The galleries would house the primary sludge pumping system and piping The heavy solids (sludge) that settle out in the clarifiers and the material that floats to the surface (scum) would be pumped to solids handling for further processing. The clarifiers would be covered and the process air sent to an odor control facility.</p> <p>Ballasted Sedimentation for split flow - The ballasted sedimentation system would consist of rectangular units. Each unit would have three sections: the injection tank where sand and coagulant are added, the maturation tank where coagulation occurs, and the settling tank where high-rate settling on inclined plate settlers takes place. The sand would be recovered from the settled solids via the hydrocyclone sand/sludge separator and reused in the ballasted process. Sludge would be pumped to solids handling for further processing. The clarifiers would be covered and the process air sent to an odor control facility.</p>	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.4.2 Location	Southwestern portion of the campus north of the headworks	Southwestern corner of facility, south of the headworks	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.4.3 Dimensions	<p>Primary clarifiers – 6 basins each 200’ x 20’ x 12’ sidewater depth (9 basins total required for Phase 2); total footprint = 180’ x 250’ x 15’ (245’ x 250’ x 15’ required for Phase 2)</p> <p>Ballasted primary clarification facility – 2 injection tanks each 12’ x 12’, 2 maturation tanks each 22’ x 25’, 2 settling tanks 25’ x 25’ (3 tanks each required for Phase 2); total footprint = 90’ x 70’ x 24’ sidewater depth (140’ x 115’ x 24’ sidewater depth required for Phase 2)</p>	Same as Route 9 site	12 Primary clarifier basins; total footprint = 350’ x 250’ x 15’ Ballasted primary facility: 4 of each tank, total footprint = 180’ x 150’ x 24’ sidewater depth	Same as Unocal Base Alternative or 72 mgd Sub-alternative
4.3.5 Secondary Treatment	Fine screening, aeration basins, and MBR process for secondary treatment			
4.3.5.1 Description of process units	<p>The purpose of secondary treatment is to remove soluble and fine suspended material that is not removed at the headworks or primary treatment. It includes fine screens, aeration basins, and membrane bioreactors (MBRs). The aeration basins and MBR tanks would be covered and the process air sent to an odor control facility</p> <p>Fine screens – The fine screens remove remaining debris and inorganic material larger than 2 mm from the wastewater. This is important to maintain the integrity of the membranes.</p> <p>Aeration Basins – Air is used in the aeration basins to promote growth of bacteria that convert carbonaceous organic matter into cell mass and create a more stable wastewater that has less organic matter to decompose. This process is called activated sludge, and the wastewater in the aeration basins is mixed liquor.</p> <p>MBRs – MBRs separate the solids from the liquid by pulling, via a vacuum pump (permeate pump), the wastewater through a membrane. The pore size of the membrane is small enough that almost all solids remain in the mixed liquor in the membrane tanks. The membrane permeate is significantly higher quality (lower TSS and BOD) than the typical secondary effluent that is achieved with the conventional activated sludge process – typically 2 mg/L or less TSS and BOD compared to 15 to 30 mg/L for conventional activated sludge.</p>	Same as Route 9 site		The lid would cover secondary processes. For the fine screens and other facilities that would fit comfortably under the lid, the spacing for the support columns would be 52’ x 52’. For the aeration basins and MBR tanks, the columns would be built into the structure of the tanks. The additional support would not require increased wall thickness or affect the channel width. In the area of the secondary clarifiers, the support column spacing would be 140’ x

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
				40’, which could be arranged around the 140’-diameter clarifiers.
4.3.5.2 Advanced treatment (tertiary) for reuse	The effluent from the MBRs meets the TSS, BOD, and turbidity requirements for Class A reclaimed water. The only additional process required is disinfection. Disinfection at a higher dose than that required for secondary effluent is required to meet a stricter total coliform limit. UV disinfection would be used for reclaimed water reuse facilities.	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.5.3 Disinfection	Flow blending structure – At flows above the split-flow threshold, effluent from the MBR system would be blended with effluent from the ballasted primary system prior to disinfection and discharge to Puget Sound. Puget Sound Discharge - Sodium hypochlorite would be used for disinfection and would be injected into the effluent prior to discharge into the effluent tunnel. The tunnel would provide sufficient contact time for the hypochlorite to react and disinfect the wastewater; therefore, no contact chamber would be needed onsite. Dechlorination, if required, would occur at an offsite portal (Portal 5 or 26) between the treatment plant and Puget Sound. Dechlorination is required to reduce the chlorine residual in the effluent to meet NPDES permit standards. However, natural degradation would occur in the effluent tunnel and, therefore, dechlorination would only be used when necessary to meet the standards. Reuse – UV would be used for reuse disinfection to achieve sufficient coliform reduction to meet Class A standards for reclaimed water. The disinfection chamber would be an open channel design, with an adjacent electrical room. Sodium hypochlorite would be added to the reuse distribution to prevent growth. The system would be located in the northern portion of the plant. The reuse chamber would be covered and the process air sent to the secondary odor control facility.	Puget Sound Discharge - Ultraviolet light (UV) would be used to disinfect the MBR effluent. The UV system would use low-pressure, high-intensity lamps. The disinfection chamber would be an open channel design, with an adjacent electrical room. The system would be located in the northern part of the plant. Sodium hypochlorite would be used to disinfect the ballasted sedimentation effluent. Flow blending structure – At flows greater than the split flow threshold, effluent from the MBR system would be blended with effluent from the ballasted primary system after disinfection and prior to discharge to Puget Sound. No dechlorination is required for the mixed effluent. Reuse – UV would be used for reuse disinfection to achieve sufficient coliform reduction to meet Class A standards for reclaimed water. The disinfection chamber would be an open channel design, with an adjacent electrical room. Sodium hypochlorite would be added to the reuse distribution to prevent growth. The system would be located in the northern part of the plant. The reuse chamber would be covered and the process air sent to the secondary odor control facility.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.5.4 Location	Center of western portion of the campus	Lower terrace of the treatment facility	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.5.5 Dimensions	Fine screening facility – 90’ x 90’ x 33’ height above finish grade (50’ total height) Aeration basins – 138’ x 450’, 4 basins each 400’ x 24’ x 25’ deep (190’ x 450’, 6 basins required for Phase 2) Membrane tanks – 200’ x 145’, 14 tanks each 120’ x 10’, 12’ deep (325’ x 145’, 20 tanks required for Phase 2) Membrane support building – 200’ x 100’ x 30’ height above finish grade (50’ total height) (300’ x 100’ required for Phase 2) Disinfection mixing box for discharge to Puget Sound – 20’ x 20’ x 15’ sidewater depth UV disinfection facility for reuse, including electrical room, 115’ x 25’ (115’ x 85’ required for Phase 2) Reuse distribution pump station – 100’ x 100’	Same as Route 9 site except for: Membrane support building – 200’ x 100’ x 20’ height above finish grade (45’ total height) (300’ x 100’ required for Phase 2)	Aeration basins – 242’ x 450’, 8 basins Membrane tanks – 410’ x 145’, 24 tanks Membrane support building – 400’ x 100’ x 20’ above finish grade (45’ total height)	Membrane support building would be 25’ above finish grade (45’ total height) and 5’ lower in elevation to fit under the multimodal lid
4.3.6 Effluent pump station	Effluent pump station is not needed	Effluent pump station required to discharge effluent to Puget Sound.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.6.1 Location and rationale	Effluent pump station is not needed	Western edge of the facility	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.3.6.2 Dimensions	Effluent pump station is not needed	Facility – 130’ x 130’ x 20’ in height above finish grade Maximum capacity – 170 mgd, 6 pumps (at buildout)	Maximum capacity – 235 mgd, 8 pumps (at buildout)	Same as Unocal Base Alternative or 72 mgd Sub-alternative
4.4 Solids Treatment				
4.4.1 Sequence of facilities	<ul style="list-style-type: none">– Primary, ballasted sedimentation, and waste activated sludge to a sludge blend tank– Thickening– Anaerobic Digestion for Class B biosolids production and reuse– Dewatering– Truck hauling to offsite reuse locations	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.4.2 Description of process units	Solids handling consists of co-thickening of primary and secondary sludge followed by anaerobic digestion and dewatering.	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
	<p>Thickening – The thickening process removes water from the blended sludge prior to anaerobic digestion and reduces the downstream storage and equipment requirements. Solids would be thickened using gravity belt thickeners (GBTs).</p> <p>Digestion – Anaerobic digestion stabilizes the sludge by converting the organic matter to methane gas and carbon dioxide. Mesophilic anaerobic digestion in multiple cylindrical tanks would stabilize the biosolids to meet Class B biosolids criteria prior to dewatering.</p> <p>Dewatering – Dewatering mechanically removes water from the digested biosolids prior to hauling by using centrifuges. The dewatered biosolids would be loaded into the trucks.</p> <p>The solids handling building, digester vents, and parked/staged biosolids trucks would have odor control systems.</p> <p>The water removed in thickening and dewatering is routed back to the secondary treatment.</p> <p>The facilities would be designed so that Class A biosolids could be produced in the future with minimal facility adjustments.</p>			
4.4.3 Location	Southwestern corner of the treatment plant near the primary treatment and maintenance facilities.	Southern portion of facility, just west of administration building	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.4.4 Dimensions	Solids handling building (includes thickening, dewatering, and biosolids truck loading) – L-shaped building, 175’ x 105’ + 45’ x 125’ x 50’ height above finish grade (60’ total height) Digesters – 4 tanks each 60’ O.D., 45’ height above finish grade (65’ total height) (6 tanks required for Phase 2) Digester building (includes pumps and other systems supporting the digesters) – 90’ x 90’ x 20’ in height above finish grade (90’ x 180’ for Phase 2)	Same as Route 9 site	8 digester tanks Digester building 90’ x 270’	Same as Unocal Base Alternative or 72 mgd Sub-alternative
4.5 Odor Control				
4.5.1 Approach	Decentralized odor control facilities would be provided for the influent pump station, preliminary and primary treatment, secondary treatment, and solids handling building. The odor control process for each facility would consist of three-stage chemical scrubbing followed by carbon polishing prior to discharge to the atmosphere. The odor control processes for the digester vents (emergency releases), digester maintenance, and truck staging would consist of carbon adsorption systems.	Same as Route 9 site.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.5.2 Location(s)	Each odor scrubbing system is located near its respective wastewater treatment process facility	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.5.3 Types of facilities or design features	18 three-stage packed tower chemical scrubbers (40,000 cfm each unit) with carbon polishing (20 scrubbers required for Phase 2) 3 carbon passive systems (7,200 cfm) for digester vents 2 carbon active systems (25,000 cfm) for maintenance on digesters 6 carbon units (1,200 cfm) connected to trucks via flexible hose for truck staging	Same as Route 9 site	22 three-stage packed tower chemical scrubbers with carbon polishing	Same as Unocal Base Alternative
4.5.4 Dimensions	- IPS – 2 primary units, 1 maintenance air unit, 1 standby unit = 120’ x 70’ - Headworks - 3 primary units, 1 maintenance air unit, 1 standby unit = 110’ x 120’ (1 additional scrubber train for Phase 2) - Secondary - 2 primary units, 2 maintenance air units, 1 standby unit = 110’ x 120’ (1 additional scrubber train for Phase 2) - Solids handling - 3 primary units, 1 standby unit = 120’ x 70’	Same as Route 9 site	- Headworks - 5 primary units, 1 maintenance air unit, 1 standby unit = 110’ x 120’ - Secondary - 4 primary units, 2 maintenance air units, 1 standby unit = 110’ x 120’	Same as Unocal Base Alternative or 72 mgd Sub-alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
4.6 Non-Process Facilities				
4.6.1 Chemical storage building	The chemical storage building would be the centralized building for chemical delivery and storage facility for the odor control system, disinfection, and ballasted primary clarification. It would contain chemical tanks, piping, and pumps to distribute chemicals to the various points of use. Day tanks and recirculation pumps and piping would be provided at each of the use points as required. The building would be 105' x 200' x 20' in height above finish grade .	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.2 Administration Building	Administration building would be located in the southern portion of the treatment facility. It is a two-story building (200' x 100' x 30' in height above finish grade) that would include the main operations room, offices, laboratory, conference room, and lockers and shower facilities.	The administration building would be located on the southeastern portion of the treatment facility. It would be similar to the building described for the Route 9 site.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.3 Facilities maintenance onsite	The maintenance building would be located in the southern portion of the campus close to the administration building and close to areas of more concentrated maintenance requirements (preliminary and primary treatment and solids handling). It would include secure parts storage, maintenance equipment and facilities for routine and minor maintenance, high-bay maintenance for heavy equipment, parking for 20 spaces, and offices and personnel spaces for maintenance staff. The building would be 200' x 100' x 30' in height above finish grade .	The maintenance building would be located on the northern portion of the treatment plant. It would include secure parts storage, maintenance equipment and facilities for routine and minor maintenance, high-bay maintenance for heavy equipment, parking for 20 spaces, and offices and personnel spaces for maintenance staff. The building would be 200' x 100' + 100' x 140' x 20' in height above finish grade . The building is L-shaped to accommodate the same square footage as at the Route 9 site, but able to fit under the multimodal lid. The building would be at elevation 20' and 20' in height above finish grade to fit under the multimodal lid.	Same as Unocal Base Alternative	Building would need to be at elevation 20 and 20' in height to fit under the multimodal lid. A 100' x 140' section would be added to make the building L-shaped.
4.6.4 Septage recovery	None	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.5 Stormwater treatment facilities				
4.6.5.1 Type	A series of ponds with constructed wetlands would be constructed to collect stormwater from the treatment plant roads, parking areas, and other pollutant-generating surfaces for treatment and detention. A canal is a central feature of the site concept that would also serve an important stormwater management function. The canal would receive runoff from roofs, low-maintenance landscaped areas, and other nonpolluting areas of the project site. In addition, the canal may receive stormwater runoff that has been treated at other locations onsite. Some underground pipe or vaults may be used to provide additional detention within or immediately adjacent to the built areas of the treatment plant.	Wet pond for water quality treatment. No detention required.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.5.2 Location	The stormwater wetlands and ponds would be on the western portion of the side. The canal would run the length of the site, along the western edge of the treatment facilities. The pipe would be underneath the main road.	The stormwater wet pond would be located at the northern corner of the site, north of the Maintenance Building.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.5.3 Capacity	A total of up to 24 acre-ft capacity is provided: Canal – 8 acre-ft of detention storage Pipe – 3 acre-ft Ponds – 13 acre-ft	2.6 acre-feet for both 36 and 54 mgd	2.6 acre-feet 2.7 acre-feet (with space reserved for CAS and Class A)	2.8 acre-feet
4.6.5.4 Routing onsite	<ul style="list-style-type: none">- Clean stormwater from roofs and other nonpolluting surfaces would drain to the large detention basin (canal) at the western edge of the plant process facilities. As the canal fills, it would output to combine the water with the treated stormwater from the ponds.- Dirty stormwater from roads, parking lots, and potentially some process facilities would connect into a large detention pipe or similar structure under the main road of the plant. The pipe could keep water cool and stored for slow release into the stormwater ponds for treatment. Alternatively, the stormwater may be directed to one or more ponds or constructed wetlands.	All runoff from pollutant-generating surfaces would be conveyed to a water quality pond for treatment. Where practical, runoff from nonpolluting surfaces would be routed directly to the stormwater outfall to Puget Sound. The 72" Edwards Way Drain crosses the site. This pipe would need to be relocated because it may conflict with project facilities.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.5.5 Discharge location	The stormwater from the canal and ponds would be conveyed to existing culverts, where adequate to convey design flows, under SR-9, and then flow to Little Bear Creek. The existing culvert for Howell Creek may require upgrading to achieve the required capacity.	Stormwater would be discharged through a new outfall at elevation –50. The outfall would run parallel to the wastewater effluent outfall to elevation –50, where the stormwater outfall would end. Willow Creek runs along the edge of the project site and is conveyed to Puget Sound in a 42" pipe. Willow Creek would be removed from this pipe and placed in a constructed	Same as Unocal Base Alternative	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
		(restored) stream channel. The treated stormwater from the project site may be conveyed to Puget Sound in the 42” pipe as an alternative to the submerged outfall outline above.		
4.6.5.6 Dimensions	Canal: 2,800’ x 60’ x 5’ deep Pipe: 6’ diameter, 6,000’ in length Ponds: 183, 225 sq. ft total	Water quality pond: 450’ x 125’ x 5’ deep	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.5.7 Reduction of stormwater generated	There are a number of approaches that can reduce the quantity of runoff and associated stormwater management facilities at the treatment plant site. Wherever practical, the footprint of the individual facilities should be minimized. This would directly reduce the amount of impervious area, the most important factor affecting the size of the stormwater facilities. Some of the process facilities may be constructed with roofs that drain into the process tanks. The rainfall reaching these facilities would enter the wastewater stream and not require collection or treatment by the stormwater system. Pervious pavement would be installed on the secondary roads and most parking lots. Where roofs are needed, they could be constructed as green roofs. Green roofs provide some detention and also flow reduction (through evapotranspiration), reducing overall stormwater detention needs at the site. Amended soils and bioretention swales would be incorporated into the landscaped area. In addition, 22 acres of forest would be planted throughout the treatment plant facilities to reduce the amount of stormwater generated. Additional low impact development measures would include rain gardens (landscaped depressions) and bioinfiltration swales to encourage local infiltration of stormwater.	Same as Route 9 site, with the exception of the forest.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.6 Energy Supply				
4.6.6.1 Electrical	Snohomish PUD would supply electrical energy to the site from their Bonneville Power Authority (BPA) SNO-KING substation via two new, independent 115 kV electrical feeders, one along SR-9 and one along 228th Street SE. A dual high-voltage substation would be located onsite in the vicinity of the SR-9 and 228th intersection. In addition, a substation would be provided onsite to step down the transmission line voltage to the voltage that would be used throughout the plant. 115-kV Electrical substation, 160’ x 150’ 15-kV Electrical substation, 100’ x 50’	Snohomish PUD’s Westgate and Richmond Park substations would supply electrical energy to the site. Approximately 4 miles of 115-kV transmission line would be necessary to bring adequate power and backup power to the site from the nearest substation, which is approximately 2 miles from the site. A dual high-voltage substation would be located on the western edge of the treatment facility, adjacent to the railroad. In addition, a substation would be provided on the plant site to step down the transmission line voltage to the voltage that would be used throughout the plant. 115 kV Electrical substation, 160’ x 150’ 15 kV Electrical substation, 100’ x 50’	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.6.2 Natural Gas	Natural gas for cogeneration would be provided by Puget Sound Energy (PSE) either via the existing 6-inch medium-pressure natural gas line that currently supplies tenants onsite, or via 3 miles of a new 6-inch high-pressure gas line from 20700 39th Avenue SE to the plant site	Natural gas for cogeneration would be provided by PSE either via 0.5 mile of new 4-inch-diameter gas line that ties into the existing 4-inch natural gas line along Third Avenue South and Dayton Street, or via 3.5 miles of a new 6-inch-diameter high-pressure gas line from 72nd Avenue West and 212th Street SW to the plant site.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.6.3 Cogeneration	The cogeneration facility would contain gas turbines, reciprocation engines, and/or fuel cells that would provide electrical power using biogas and natural gas as the fuel source. The facility would provide sufficient power to run the entire treatment facility at AWWF capacity, including the influent pump station. Cogeneration facility, 150’ x 100’	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.6.4 Redundancy of energy supply	The BPA SNO-KING substation is a major, dual substation, with primary power feeds from BPA and auxiliary feeds from Seattle City Light and PSE. This substation is the major electrical substation in Snohomish County. It is considered extremely reliable and, coupled with the two independent high-voltage feeders to the plant, would provide redundancy to meet permit requirements for reliability. The cogeneration facilities would provide additional redundancy up to the AWWF capacity of the plant.	Snohomish PUD’s Westgate and Richmond Park substations would supply electricity to the Unocal site. The BPA SNO-KING substation provides feeds to the local substations. The BPA SNO-KING substation is a major, dual substation, with primary power feeds from BPA and auxiliary feeds from Seattle City Light and PSE. This substation is the major electrical substation in Snohomish County. It is considered extremely reliable and, coupled with the two independent high-voltage feeders to the plant, would provide redundancy to meet permit requirements for reliability. The cogeneration facilities would provide additional redundancy up to the AWWF capacity of the plant.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.6.5 Standby power	One standby diesel generator of approximately 250 kW output for Phase 1 and 500 kW output for Phase 2 would be provided for backup power to serve essential life and safety needs and to start the cogeneration turbines. Fuel storage would be provided for 48 hours of operation. For Phase 1, 1,000 gallons of diesel fuel would be stored in an aboveground tank. For Phase 2, 2,000 gallons of diesel fuel would be stored.	Same as Route 9 site	A 500-kW emergency generator would be provided, with 2,000 gallons of diesel fuel storage.	Same as Unocal Base Alternative
4.6.6.6 Boilers	Hot water boilers (250 hp each) would be located in the cogeneration facility. - 2 boilers for 36 mgd - 3 boilers for 54 mgd	Same as Route 9 site	4 boilers for 72 mgd	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
4.6.7 Internal roads and parking				
4.6.7.1 Internal roads	A series of primary and secondary roads would be included with the plant site to provide vehicular access to all major unit treatment processes and related buildings for maintenance and repair. Primary roads would be those most heavily traveled, including those used for biosolids, screening, grit, and chemical hauling. Secondary roads would be those used less frequently for operation and maintenance access.	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.7.2 Parking	50 spaces near the administration building for plant staff and visitors 20 spaces at the maintenance building 100 spaces at the community-oriented building 10 spaces near solids handling	50 spaces near the administration building for plant staff and visitors 20 spaces at the maintenance building 10 spaces near solids handling	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.8 Community-oriented building	A community-oriented building may be provided as an element of mitigation to enhance public awareness and understanding of environmental issues and to convey the full aspects of the natural water and wastewater cycles through education programs for school groups and provide meeting and event space for community members.	Mitigation measures similar in nature to the community-oriented building at the Route 9 site would be provided at the Unocal site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.8.1 Physical dimensions and use	A two-story building (approximately 10-20,000 sq. ft.) that would accommodate a large meeting room, several smaller classrooms, an exhibit lobby, an artist space, a theater, and administrative and support services. Parking would be provided for 100 spaces. An estimated 8 buses per day would be used to transport groups to and from the community oriented building.	To Be Determined	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.8.2 Location	Western portion of the site, just southwest of the administration building. The community-oriented building would not be located within the boundaries of the treatment facilities	To Be Determined	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.8.3 Capacity	Potential to accommodate up to 150 people	To Be Determined	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.9 Other Support Facilities	Storage area for large parts and plant maintenance vehicles. It would be a carport-type facility (40' x 80') and have room for 6 vehicles	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
4.6.10 LEED Rating	LEED is an acronym for Leadership in Energy and Environmental Design. LEED is a green building rating system that is promoted and technically updated by the U.S. Green Building Council, a nonprofit organization based in Washington, D.C. The LEED system awards points for achieving various green criteria, such as reducing water consumption by 20%. Buildings and projects are awarded various certification levels (Basic, Silver, Gold, and Platinum) if they meet minimum criteria. LEED is rapidly gaining broad acceptance and application in the design and construction of buildings. Brightwater is likely one of the first, if not the first, wastewater treatment plants to apply LEED sustainable building guidelines to an infrastructure project. The goal for Brightwater is a Silver LEED rating minimum for campus buildings.	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative

5.0 Treatment Plant Operations – Phase 1 (36 mgd)				
5.1 Liquids Stream Operation				
5.1.1 Effluent quality by alternative (MBR/ split flow)	MBR – extremely high quality effluent, BOD ₅ = 2 mg/L, TSS = 2 mg/L, ammonia nitrogen < 1.0 mg/L. Annual loading of 219,000 lb BOD and 219,000 lb TSS. CAS – BOD ₅ = 20 mg/L, TSS = 20 mg/L, 19 mg/L ammonia nitrogen. Annual loading of 2.2 million lb BOD and 2.2 million lb TSS. Split-flow treatment process would reduce the annual discharge of pollutants by 75% or more compared to a CAS process. Typical effluent permit limits for WWTPs are 30 mg/L BOD ₅ and 30 mg/L TSS	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.1.2 Mechanical processes that may create impacts	Influent pump station – Pumps, wastewater channels Preliminary treatment – Mechanically cleaned bar screens that remove large objects from wastewater, covered aerated grit basins that remove grit from wastewater Conventional primary system – Rectangular primary clarifier units equipped with sludge and scum collection systems. Influent distribution is accomplished through the	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
	channel and weirs. Effluent is collected via weirs and launderers and flows to an effluent collection channel. Ballasted Sedimentation - two units, each with three sections: the injection tank where sand and coagulant are added, the maturation tank where coagulation occurs, and the settling tank where high-rate settling on inclined plate settlers takes place. The sand is recovered from the settled solids and reused. Sludge pumps. Aeration Basins – Air is used in the aeration basins to promote growth of bacteria that convert carbonaceous organic matter into cell mass and create a more stable wastewater that has less organic matter to decompose. Aeration blowers and membrane basin lift pump. MBRs – MBRs separate the solids from the effluent by pulling, via a vacuum pump (permeate pump), the wastewater through a membrane. The pore size of the membrane is small enough that most solids remain in the mixed liquor in the membrane tanks.			
5.1.3 Chemicals stored and used	See Section 5.4.2.2	See Section 5.4.2.2	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.1.4 Staff required and/or automation	See Section 5.4.5	See Section 5.4.5	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.1.5 Contingency planning for upset	1) Use of redundant source of power 2) Storing flows in new and existing influent conveyance pipelines and tunnels 3) Diversion of excess flows into the existing Logboom and North Creek Storage Facilities 4) Diversion of flows to the West Point and South Treatment Plants 5) Use of cogeneration in the event of power outages on both feeders 6) Diversion of untreated wastewater through new safety relief at Kenmore	In addition to emergency management system, the Unocal site would have a safety relief system to discharge influent wastewater to Puget Sound via a bypass from the influent pump station wet well to the plant’s effluent outfall. The bypass from the wet well would be equipped with a gate that would open automatically should the influent pumps or effluent pumps fail.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.1.6 By-products storage, removal, and disposal	Estimated quantities for Phase 1, AWWF: - Coarse screenings – 0.4 cubic yards/day to landfill - Grit – 0.4 cy/day to landfill - Fine screenings – 3.9 cy/day to landfill Disposal: 2 32-ton truck trips/week	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
5.2 Solids Stream Operation				
5.2.1 Types of facilities	Gravity belt thickeners Anaerobic digestion Centrifuge dewatering Digester control building Cogeneration	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.2 Number of facilities	Solids handling building, which houses 4 GBTs and 3 centrifuges 4 digesters Digester control building	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.3 Process flow (and redundancy)	Primary sludge and split-stream primary sludge are combined with waste-activated sludge and thickened with GBTs. The thickened sludge is anaerobically digested and dewatered with the centrifuges. Standby GBTs, pumps, and centrifuges would be included in the design.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.4 Quantity produced	See Section 5.2.6	See Section 5.2.6	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.5 Quality	Will meet Class B requirements for reuse on forest and agricultural lands	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.6 Byproducts storage, removal, and disposal	Estimated quantities for Phase 1, AWWF: 76.4 cy/day (64.4 wet tons/day) of biosolids for land application Storage: Brightwater would have the capacity to store biosolids cake as a means to keep the treatment plant in operation if the biosolids trucks cannot leave the site (e.g., bad weather on the pass to eastern Washington). Several methods are available for biosolids or sludge storage. Solids handling is an area that would be reviewed and further optimized during Phase 1 predesign. For the EIS, the following biosolids storage options were included: <ul style="list-style-type: none">Raw sludge blend tankDigested solids storage in an additional digesterDewatered cake storage in staged trucks onsite, with dedicated truck odor control systems Disposal: see Section 5.2.9.2.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.7 Chemicals used and stored	See Section 5.4.2.2	See Section 5.4.2.2	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.8 Mechanical equipment that may create impacts	<ul style="list-style-type: none">Solids handling consists of co-thickening of primary and secondary sludge followed by anaerobic digestion and dewatering. Thickening process removes water from the blended sludge prior to anaerobic digestion and reduces the downstream storage and equipment requirements. Anaerobic digestion stabilizes the sludge by converting the organic matter to methane gas and carbon dioxide. Dewatering mechanically removes water from the digested biosolids prior to hauling. It reduces the cost of transporting the biosolids cake, as well as the size of equipment and storage. Solids would be thickened using gravity belt thickeners (GBTs) and dewatered using centrifuges.Mechanical equipment includes the GBTs, GBT feed pumps, thickened sludge pumps, centrifuges, and centrifuge feed pumps.The biosolids trucks would have provisions for odor control. Flexible hose would be used to connect the trucks parked in the staging area to a carbon system for odor control prior to the trucks leaving the site.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.9 Transport (and loading)				
5.2.9.1 Type of truck, capacity, and size	Double-dump-bed trucks with overall capacity of 65,700 lb (32 tons). 70' in length overall.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.9.2 Number of biosolids truck trips per day	2 32-ton truckloads per day AWWF	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.9.3 Onsite storage and staging	Biosolids would be loaded directly into trucks . There would be capacity for staging of 8 biosolids trucks (6 outside and 2 in the bays)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.2.9.4 Hauling hours	Hauling operations would occur during daytime hours, mainly early in the morning to avoid Puget Sound area traffic and to arrive at land application sites during the daytime	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
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5.2.9.5 Loading operations	Biosolids would be loaded into trucks in an enclosed loading area that is vented to the solids odor control scrubbers. Loading of trucks would occur 24 hours per day. Trucks would be staged until hauling operations begin.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.3 Odor Control				
5.3.1 Mechanical processes that may create impacts	Odor control includes covered influent wet well, screenings and grit handling, covered primary clarifiers, covered aeration basins and membrane tanks, as well as enclosed thickening and dewatering equipment and the loading operation for each of the byproducts. Process air from the facilities is collected and sent to three-stage chemical scrubbers with carbon polishers for treatment before it is discharged to the atmosphere. There are four main odor control systems: <ul style="list-style-type: none">- Influent pump station- Preliminary and primary- Secondary- Solids Handling Each system has capability to treat the process air, has a redundant unit, and has additional units to allow treatment of air used to ventilate an empty basin during routine maintenance. Each odor control system has associated exhaust fans, scrubber recirculation pumps, and chemical metering pumps. In addition, there are smaller carbon adsorption odor treatment units for the digester vents, digesters during maintenance, and the biosolids truck staging.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.3.2 Standards	The odor control facilities would meet these standards at the stack: Hydrogen sulfide (H ₂ S) < 2.4 ppbV Ammonia (NH ₃) < 8,400 ppbV Odor < 3 Dilutions-to-Threshold (D/T)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.3.2 Chemicals used and stored	See Section 5.4.2.2	See Section 5.4.2.2	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.3.4 Volume of air treated	Influent pump station – 60,000 cfm Preliminary and primary – 80,000 cfm Secondary – 60,000 cfm Solids Handling – 60,000 cfm Digester vents – 21,600 cfm Digester maintenance – 50,000 cfm Truck staging – 7,200 cfm Total = 338,800 cfm	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4 Non-Process and Auxiliary Operations				
5.4.1 Reclaimed water			Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.1.1 Production	5 mgd	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Process chain	MBR treatment followed by UV disinfection	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Standards	2.2 total coliform/100 mL	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Chemical or mechanical processes	The UV system would use low-pressure, high-intensity lamps to achieve high-level disinfection while keeping energy costs relatively low. The disinfection chamber would be an open channel design, with an adjacent electrical room. The reuse chamber would be covered and the process air sent to the secondary odor control facility.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Volume of reclaimed water produced and stored	5 mgd produced There is no storage of reclaimed water	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
5.4.1.2 Distribution of reclaimed water				
- Onsite distribution and use	Up to 3 mgd of reclaimed water would be used onsite for irrigation, washdown, and other process and maintenance purposes	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Opportunities for offsite distribution and use	Water would be used offsite for irrigation as demand is identified and contracted. Sodium hypochlorite would be added to reuse distribution to prevent growth.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
5.4.2 Materials/chemicals used in process				
5.4.2.1 Fuel use, delivery and storage	See Section 4.6.6.5	See Section 4.6.6.5	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.2.2 Chemical, use, delivery and storage	<ul style="list-style-type: none">All chemical storage and handling would comply with applicable local, state, and federal regulations, such as the Uniform Fire Code (UFC), Resource Conservation and Recovery Act (RCRA), and OSHA. Chemicals would be delivered by trucks; capacity of typical chemical delivery truck = 4,800 gallons. The tanks and bins would be designed with high and low level indicators to promote troublefree, continuous feed and would have containment and safety provisions meeting all applicable requirements. The chemical building would be provided with appropriate containment, ventilation, and emergency alarm systems in case of spilling.- Chemical use quantities are provided for each use of each chemical; storage and delivery quantities are provided for the total usage of each chemical.	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hydroxide for odor control	Use = 1,083,000 gallons/year Storage = 92,000 gallons for all sodium hydroxide Delivery = 20 tanker trucks/month (4,800-gallon capacity) for all sodium hydroxide	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hypochlorite for odor control	Use = 106,000 gallons/year Storage = 59,705 gallons for all sodium hypochlorite Delivery = 13 tanker trucks/month (4,800-gallon capacity) for all sodium hypochlorite	Use = 106,000 gallons/year Storage = 42,486 gallons for all sodium hypochlorite Delivery = 9 tanker trucks/month (4,800-gallon capacity) for all sodium hypochlorite	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hypochlorite for prechlorination	Use = 313, 760 gallons/year	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hypochlorite for disinfection	Use = 210,800 gallons/year	Use = 4,170 gallons/year	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hypochlorite for UV reuse chlorination	Use = 15,000 gallons/year	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sulfuric acid for odor control	Use = 11,785 gallons/year Storage = 982 gallons Delivery = 1 tanker truck/month (4,800-gallon capacity)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Virgin activated carbon for odor control	Use = 226,000 lb/year Storage = 18,833 lb Delivery = 6 trucks/year (20-ton capacity)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Ferric chloride for ballasted sedimentation	Use = 33,095 gallons/year Storage = 48,000 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium bisulfite for dechlorination	Use = 51,000 gallons/year Storage = 5,167 gallons for all sodium bisulfite Delivery = 2 tanker trucks/month for all sodium bisulfite (4,500-gallon capacity)	Not required for Unocal site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Polymer for sludge thickening and dewatering	Use = 278,000 lb/year Storage = 23,167 lb Delivery = 2 trucks/month (20-ton capacity)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hypochlorite for membrane cleaning	Use = 70,900 gallons/year	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Citric acid for membrane cleaning	Use = 15,000 gallons/year Storage = 1,250 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium hydroxide for membrane cleaning	Use = 21,000 gallons/year	Same as Route 9 site	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
- Sodium bisulfite for membrane cleaning	Use = 11,000 gallons/year	Use = 11,000 gallons/year Storage = 917 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)		

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
5.4.3 Energy supply/generation facilities	Electrical service would need to be extended to the plant site via transmission voltage service (115 kV). Snohomish PUD is extending transmission level service to this location via two 115- kV transmission lines. These lines are being routed from the BPA SNO-KING substation. The Parkridge line is already built out to the Route 9 site, while the Clearview line is now within about a mile. Snohomish PUD has suggested that a 115-kV substation could be sited at the plant and the two lines looped through so that service would be available via either line. A new 115-kV electrical substation would be built as part of the treatment plant. In addition, a 15-kV substation would be built to distribute power throughout the plant.	Electrical service would need to be extended to the plant site via transmission voltage service (115 kV). Snohomish PUD would extend transmission level service to this location via two 115-kV transmission lines. These lines would be routed from the BPA SNO-KING substation through the Westgate and Richmond Park substations. A new 115-kV electrical substation would be built as part of the treatment plant. In addition, a 15-kV substation would be built to distribute power throughout the plant.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.3.1 Average annual energy load	7.7 mW	7.9 mW	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.3.2 Average annual energy consumption	46 – 67 million kWh	47 – 67 million kWh	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.4 Other utilities to site				
5.4.4.1 Potable water	The Cross Valley Water District, which draws potable water from a sole-source aquifer, currently provides drinking water to over 5,400 connections in unincorporated Snohomish County. The District’s supply is 10 groundwater wells drawing from the Cross Valley sole-source aquifer and surface water purchased from the City of Everett. The District provides water service to the majority of properties within the Route 9 site. Properties north of Stockpot Culinary Campus, outside the UGA, draw water from individual wells connected to the Cross Valley sole-source aquifer. Water demand from customers onsite from July 1, 2001, to June 30, 2002, was 40 gpm, including Stockpot.	The City of Edmonds owns and operates a major water distribution system that provides potable water in the Unocal site vicinity. The Alderwood Water and Wastewater District supplies approximately 65% of the City’s water, and Seattle Public Utilities contributes the remaining 35%. Both utilities are responsible for maintaining and operating water treatment and source facilities.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.4.2 Communications	T-Mobile provides telecommunication service, including telephone service, in the vicinity of the Route 9 site.	T-Mobile provides telecommunications service, including residential telephone service to customers near the Unocal site. T-Mobile underground telephone conduits are located near the Unocal site.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.4.3 Solid waste	There are no solid waste facilities on or in close proximity to the Route 9 site. The transfer station nearest the site is the Snohomish County Southwest Recycling and Transfer Station in Mountlake Terrace. This transfer station is located approximately 8 miles west of the site. The First Northeast Transfer Station, approximately 10 miles southwest in the City of Shoreline, is the nearest solid waste facility in King County.	There are no solid waste facilities on or in close proximity to the Unocal site. The Snohomish County Southwest Recycling and Transfer Station is in Mountlake Terrace, approximately 3 miles east of the site . The nearest solid waste transfer station in King County is the First Northeast Transfer Station, located in the City of Shoreline approximately 4.5 miles southeast of the Unocal site.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.4.4 Dewatering	<ul style="list-style-type: none">Approximately 350 gpm maximum from subdrains, seasonal variationDischarge of the water removed from dewatering during operations would be decided during final design. Potential options for discharge include discharging to portions of the stormwater treatment system and discharging to a stream adjacent to the site.	There would be no long-term groundwater dewatering required at the Unocal site.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.5 Employees				
5.4.5.1 Numbers of employees	47 – 52, plus an additional 3 – 7 FTEs for the community-oriented building	47 – 52	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative
5.4.5.2 Work hours by shift	The total number of employees during the day would be 33 - 39, including process, administration, maintenance, coordination, and 1 operator shift (3 FTEs). The day shift would also include the 3 – 7 FTEs for the community-oriented building. In addition, there would be 4 crews (A, B, C, D), with 3 FTEs each, working 12-hour shifts.	The total number of employees during the day would be 33 - 39, including process, administration, maintenance, coordination, and 1 operator shift (3 FTEs). In addition, there would be 4 crews (A, B, C, D), with 3 FTEs each, working 12-hour shifts.	Assume same as Unocal Base Alternative	Assume same as Unocal Base Alternative

6.0 Treatment Plant Operations – Phase 2 (54 mgd) (Only changes from Phase 1 included in this section)				
6.1 Liquid Stream Operation				
6.1.1 Effluent quality by alternative (MBR/ split flow)	MBR – annual loading of 328,500 lb BOD and 328,500 lb TSS. CAS – annual loading of 3.3 million lb BOD and 3.3 million lb TSS.	Same as Route 9 site	MBR – annual loading of 428,000 lb BOD and 438,000 lb TSS. CAS – annual loading of 4.4 million lb BOD and 4.4 million lb TSS.	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.1.2 Mechanical processes that may create impacts	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.1.3 Chemicals stored and used	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2
6.1.4 Staff required and/or	See Section 6.4.5	See Section 6.4.5	See Section 6.4.5	See Section 6.4.5

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
automation				
6.1.5 Contingency planning for upset	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.1.6 Byproducts storage, removal, and disposal	Estimated quantities for Phase 2, AWWF: - Coarse screenings – 0.6 cy/day to landfill - Grit – 0.6 wet tons/day to landfill - Fine screenings – 5.9 cy/day to landfill Disposal: 3 32-ton truck trips/week	Same as Route 9 site	- Coarse screenings – 0.8 cy/day - Grit – 0.8 wet tons/day - Fine screenings – 7.8 cy/day Disposal: 4 32-ton truck trips/week	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.2 Solids Stream Operation				
6.2.1 Types of facilities	Same as Phase 1	Same as Route 9 site		
6.2.2 Number of facilities	Solids handling building, which houses the 5 GBTs and 4 centrifuges 6 digesters Digester control building	Same as Route 9 site	Solids handling building, includes 6 GBTs and 5 centrifuges 8 digesters Digester control building	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.2.3 Process flow (and redundancy)	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.4 Quantity produced	See Section 6.2.6	See Section 6.2.6	See Section 6.2.6	See Section 6.2.6
6.2.5 Quality	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.6 Byproducts storage, removal, and disposal	Estimated quantities for Phase 2, AWWF: 114.6 cy/day (96.6 wet tons/day) of biosolids for land application Disposal: see Section 6.2.9.2.	Same as Route 9 site	152.8 cy/day (128.8 wet tons/day) of biosolids	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.2.7 Chemicals used and stored	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2
6.2.8 Mechanical equipment that may create impacts	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.9 Transport (and loading)				
6.2.9.1 Type of truck, capacity, and size	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.9.2 Number of biosolids truck trips per day	3 truckloads per day, AWWF	Same as Route 9 site	4 truckloads per day, AWWF	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.2.9.3 Onsite storage and staging	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.9.4 Hauling hours	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.2.9.5 Loading operations	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.3 Odor Control				
6.3.1 Mechanical processes that may create impacts	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.3.2 Standards	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.3.2 Chemicals used and stored	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2	See Section 6.4.2.2
6.3.4 Volume of air treated	- Influent pump station – 60,000 cfm - Preliminary and primary – 100,000 cfm - Secondary – 80,000 cfm - Solids handling – 60,000 cfm - Digester vents – 21,600 cfm - Digester maintenance – 50,000 cfm - Truck staging – 7,200 cfm Total = 378,800 cfm	Same as Route 9	Same as Unocal Base Alternative	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
6.4 Non-Process and Auxiliary Operations				
6.4.1 Reclaimed water				
6.4.1.1 Production	Up to 54 mgd capacity reserved onsite	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Process chain	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Standards	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Chemical or mechanical processes	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Volume of reclaimed water produced and stored	Up to 54 mgd based on identified and contracted demand	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.1.2 Distribution of reclaimed water				
- Onsite distribution and use	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Opportunities for offsite distribution and use	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
6.4.2 Materials/chemicals used in process				
6.4.2.1 Fuel use, delivery, and storage	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.2.2 Chemical, use, delivery, and storage	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Sodium hydroxide for odor control	Use = 1,624,500 gallons/year Storage = 137,125 gallons for all sodium hydroxide Delivery = 29 tanker trucks/month (4,800-gallon capacity) for all sodium hydroxide	Same as Route 9 site	Use = 2,166,000 gallons/year; storage = 182,250 gallons; delivery = 38 tanker trucks/month for all sodium hydroxide	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hypochlorite for odor control	Use = 159,000 gallons/year Storage = 98,228 gallons for all sodium hypochlorite Delivery = 21 tanker trucks/month (4,800-gallon capacity) for all sodium hypochlorite	Storage = 72,400 gallons for all sodium hypochlorite Delivery = 16 tanker trucks/month (4,800-gallon capacity) for all sodium hypochlorite	Use = 212,000 gallons/year; storage = 90,063 gallons; delivery = 19 tanker trucks/month for all sodium hypochlorite	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hypochlorite for prechlorination	Use = 470,639 gallons/year	Same as Route 9 site	Use = 627,519 gallons/year	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hypochlorite for disinfection	Use = 316,200 gallons/year	Use = 6,255 gallons/year	Use = 8,340 gallons/year	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hypochlorite for UV reuse chlorination	Use = 162,000 gallons/year	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Sulfuric acid for odor control	Use = 17,678 gallons/year Storage = 1,473 gallons Delivery = 1 tanker truck/month (4,800-gallon capacity)	Same as Route 9 site	Use = 23,570 gallons/year; storage = 1,964 gallons; delivery = 1 tanker truck/month	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Virgin activated carbon for odor control	Use = 300,000 lb/year Storage = 25,000 lb Delivery = 8 trucks/year (20-ton capacity)	Same as Route 9 site	Use = 370,000 lb/year; storage = 30,833 lb; delivery = 10 trucks/year	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Ferric chloride for ballasted sedimentation	Use = 49,643 gallons/year Storage = 8,000 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)	Same as Route 9 site	Use = 66,190 gallons/year; storage = 8,000 gallons; delivery = 2 tanker trucks/month	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium bisulfite for dechlorination	Use = 77,000 gallons/year Storage = 7,333 gallons for all sodium bisulfite Delivery = 2 tanker trucks/month (4,500-gallon capacity) for all sodium bisulfite	Not required for Unocal site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
- Polymer for sludge thickening and dewatering	Use = 417,000 lb/year Storage = 34,750 gallons Delivery = 2 trucks/month (20-ton capacity)	Same as Route 9 site	Use = 556,000 lb/year; storage = 46,333 gallons; delivery = 2 trucks/month	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hypochlorite for membrane cleaning	Use = 70,900 gallons/year	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Citric acid for membrane cleaning	Use = 15,000 gallons/year Storage = 1,250 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium hydroxide for membrane cleaning	Use = 21,000 gallons/year	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative or 72 mgd Sub-alternative
- Sodium bisulfite for membrane cleaning	Use = 11,000 gallons/year	Use = 11,000 gallons/year Storage = 917 gallons Delivery = 1 tanker truck/month (4,500-gallon capacity)	Same as Unocal Base Alternative	Same as Unocal Base Alternative or 72 mgd Sub-alternative

		Unocal		
	Route 9	Base Alternative	72 mgd Sub-alternative	Multimodal Lid Sub-alternative
6.4.3 Energy generation facilities	Same as Phase 1	Same as Phase 1	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.3.1 Average annual energy load	13.2 mW	13.3 mW	16.1 mW	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.4.3.2 Average annual energy consumption	79 – 114 million kWh	79 – 114 million kWh	96 – 138 million kWh	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.4.4 Other utilities to site				
6.4.4.1 Potable water	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.4.2 Communication	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.4.3 Solid Waste	Same as Phase 1	Same as Route 9 site	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.4.4 Dewatering	Approximately 400 gpm maximum from subdrains, seasonal variation. For 54 mgd CAS, approximately 700 gpm maximum.	There would be no long-term groundwater dewatering required at the Unocal site.	Same as Unocal Base Alternative	Same as Unocal Base Alternative
6.4.5 Employees				
6.4.5.1 Number of employees	67 – 75, plus an additional 3 – 7 FTEs for the community-oriented building	67 – 75	90 - 100	Same as Unocal Base Alternative or 72 mgd Sub-alternative
6.4.5.2 Work hours by shift	Day shift employees: 41 – 49, plus the 3 – 7 FTEs for the community-oriented building	Day shift employees: 41 – 49	Day shift employees: 53 - 65	Same as Unocal Base Alternative or 72 mgd Sub-alternative
7.0 Construction Of Route 9 Treatment Plant – See Construction Schedule Technical Appendix (to be provided by URS)				

Attachment B – Design Criteria

Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
	Rt 9			Unocal				
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Influent Pump Station								
Total Dynamic Head (TDH) (ft)	240	240	240	140	140	140	140	
Number of stages	2	2	2	1	1	1	1	
Total number of influent pumps	8 + 2 standby	10 + 2 standby	10 + 2 standby	4 + 1 standby	5 + 1 standby	7 + 1 standby	7 + 1 standby	
Capacity of pump, mgd each	35	34	34	35	34	34	34	
Inside diameter of shaft below ground, ft	110	110	110	110	110	110	110	
Footprint size of pump station building (ft)	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	
Headworks Bldg (Screening + degritting)								
Footprint size (ft)	130x 92 x 50 H	130x 92 x 50 H	130x 92 x 50 H	130x 92 x 50 H	130x 92 x 50 H	130x 92 x 50 H	130x 92 x 50 H	Includes 4 stairwells and 2 enclosed truck loading bays
Screens								
Number of units:	4+2	6+2	5+1	4+2	6+2	8+2	6+1	6 mm for MBR (ballasted sed); 3/8 inch for CAS
Vortex grit chamber Alternative to Aerated Grit Basins (Use Aerated Grit Basins for Cost Estimate)								
Length x width x H (ft)	24 Dia	24 Dia	24 Dia	24 Dia	24 Dia	24 Dia	24 Dia	
Sidewater depth (ft)	8	8	8	8	8	8	8	
Number of units:	2 + 1	3+1	3+1	2 + 1	3+1	4+1	4+1	
Footprint size (ft)	100 x 40	100 x 80	100 x 80	100 x 40	100 x 80	100 x 80	100 x 80	
Aerated Grit								Use aerated grit for cost estimate
Length x width (ft)	60 x 20	60 x 20	60 x 20	60 x 20	60 x 20	60 x 20	60 x 20	
Sidewater depth (ft)	15	15	15	15	15	15	15	
Volume each	135,000 gal	135,000 gal	135,000 gal	135,000 gal	135,000 gal	135,000 gal	135,000 gal	
No. of units	3	4	4	3	4	6	6	
Grit Aeration Blowers								
No. of units	2 +1	3 +1	3 +1	2 +1	3 +1	4+1	4 +1	
Capacity	1200 scfm	1200 scfm	1200 scfm	1200 scfm	1200 scfm	1200 scfm	1200 scfm	
Grit Pumping								
No. of units	9	15	15	9	15	18	18	
Capacity	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	
Footprint								Includes galleries below and channels above
Length x width (ft)	100 x 80	100 x100	100 x100	100 x 80	100 x100	100 x 160	100 x 160	
Primary Clarification for Main Treatment Flow								
Conventional Primary Clarifiers								
Length x width (ft)	200 x 20	200 x 20	200 x 20	200 x 20	200 x 20	200 x 20	200 x 20	
Sidewater depth, ave. (ft)	12	12	12	12	12	12	12	
Number of units:	6	9	10	6	9	12	14	
Basin footprint size (ft)	180 x 250 x 15	245 x 250 x 15	300 x 250 x 15	180 x 250 x 15	245 x 250 x 15	350 x 250 x 15	380 x 250 x 15	Includes longitudinal galleries and galleries at both ends of tanks
Building footprint (WxLxH)	20 x 180 x 15	20 x 245 x 15	20 x 300 x 15	20 x 180 x 15	20 x 245 x 15	20 x 350 x 15	20 x 380 x 15	
Primary Sludge Pumps								
No. of units	6 + 3	9 + 5	11 + 6	6 + 3	9 + 5	12 + 6	16 + 8	
Capacity each	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	100 gpm	

Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
		Rt 9			Unocal			
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Ballasted Sedimentation for Split Stream Flow								
Injection Tank								
Length (ft)	12	12		12	12	12		
Width (ft)	12	12		12	12	12		
Sidewater Depth, ave. (ft)	26	26		26	26	26		
Maturation Tank								
Length (ft)	22	22		22	22	22		
Width (ft)	25	25		25	25	25		
Sidewater Depth, ave. (ft)	26	26		26	26	26		
Settling Tank								
Length (ft)	25	25		25	25	25		
Width (ft)	25	25		25	25	25		
Sidewater depth, ave. (ft)	26	26		26	26	26		
Number of units:	2	3		2	3	4		
Footprint size (ft)	115 x 70 x 30	115 x 125 x 30		115 x 70 x 30	115 x 125 x 30	115 x 140 x 30		
Fine Screening Facility								2-mm punch plate screens @ 20 mgd/ea
Number of primary effluent screens:	3+1	4+1		3+1	4+1	6+1		
Length of channel (ft)	38	38		38	38	38		Includes influent and effluent channels
Width of channel (ft)	4	4		4	4	4		
Channel Depth (ft)	14	14		14	14	14		Additional Depth - Head for RAS Screening
								Includes 2 stairwells and 2 enclosed truck loading bays; assume building construction in Phase 1 for Phase 2 requirements
Building Footprint size (ft)	90 X 90 X 50H	90 X 90 X 50H		90 X 90 X 50H	90 X 90 X 50H	90 X 90 X 50H		
Aeration Basins								
Length (ft)	400	400	400	400	400	400	400	
Width (ft)	24	24	24	24	24	24	24	
Sidewater depth (ft)	25	25	25	25	25	25	25	
Number of units:	4	6	9	4	6	8	12	
Aeration Blowers - Process Air								Single Stage Centrifugal - High efficiency; Blowers located in gallery
Number	4+1	6+1	6+1	4+1	6+1	8+1	8+1	
Blower capacity/ea, scfm	15,000	15,000	17750	15,000	15,000	15,000	17750	
Blower discharge pressure (psi)	12	12	12	12	12	12	12	
Footprint (ft)	130 x 450 x 28	184 x 450 x 28	270 x 450 x 28	130 x 450 x 28	184 x 450 x 28	230 x 450 x 28	310 x 450 x 28	Includes 30 ft gallery between tanks and 20 ft gallery at each end of tanks
Covers								Assume low profile pyramid hatches on 20x20 grid; hatches to be removable; hatches to also contain convenient visual access for full length of each basin; assume portable bridge crane for cover removal.

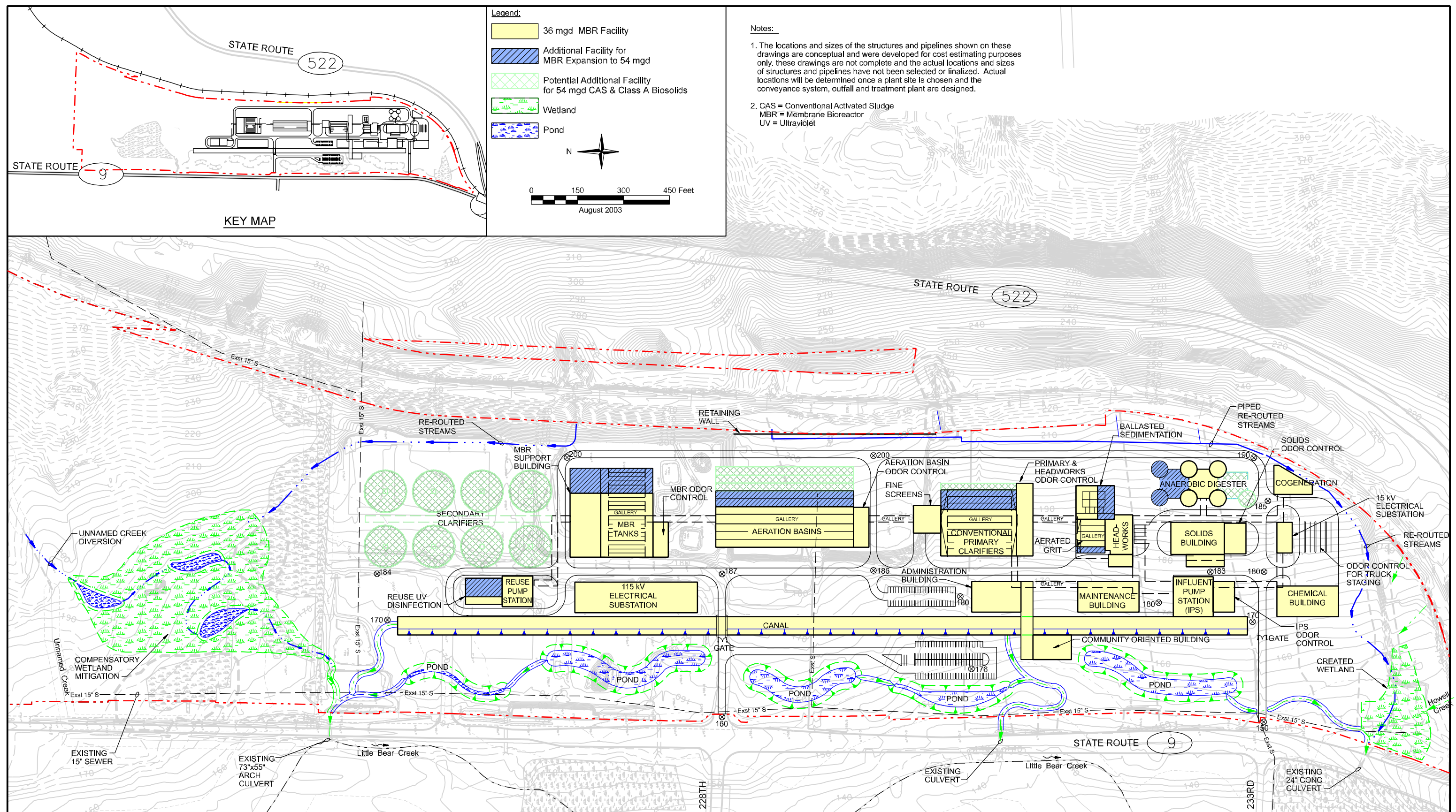
Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
		Rt 9			Unocal			
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Bisulfite Mix Box - Puget Sound Discharge								Located at a remote site (portal) and will require full utility service.
Design detention time (sec)								
At average flow	20	20	20					
At peak hour flow	10	10	10					
Volume (gallons)	19,700	19,700	19,700					
Number of units	1	1	1					
Length x width (ft)	28 x 10	28 x 10	28 x 10					
Sidewater depth (ft)	10	10	10					
Footprint size (ft)	40 x 40 x 20	40 x 40 x 20	40 x 40 x 20					
Disinfection for Main Stream (UV System) - Puget Sound Discharge								The UV system at Unocal site is for main stream disinfection only for split flow MBR alternatives and full CAS alternative
Disinfection limit (coliform/100 mL)				200	200	200	200	
No. of channel				2	3	4	6	
No. of banks per channel				2	2	2	2	
No. of modules per bank				13	13	13	28	
No. of lamps per module				8	8	8	8	
Total no. of lamps				416	624	832	2688	
Channel width (inch)				52	52	52	112	
Footprint (ft)								
Basin				20 x 70	30 x 70	50 x 70	90 x 70	
Electric room				30 x 70 x 20 H	30 x 70 x 20 H	30 x 70 x 20 H	30 x 70 x 20 H	
Total				50 x 70	60 x 70	80 x 70	120 x 70	
Disinfection (UV System) - Reuse								
Disinfection limit (coliform MPN/100 ml)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	
UV transmittance	65%	65%	65%	65%	65%	65%	65%	
UV dose (mW-s/cm2)	100	100	100	100	100	100	100	
Initial flow (mgd)	5	5	5	5	5	5	5	
Buildout flow (mgd)	54	54	54	54	54	54	54	
Phase 1 - Use 5 mgd modular design with single channel and bypass								
No. of channels	1	1	1	1	1	1	1	
No. of banks per channel	4	4	4	4	4	4	4	
No. of modules per bank	13	13	13	13	13	13	13	
No. of lamps per module	8	8	8	8	8	8	8	
Total no. of UV lamps	416	416	416	416	416	416	416	
Minimum channel length (ft)	54	54	54	54	54	54	54	
Channel width (inch)	45	45	45	45	45	45	45	
Channel maximum depth (inch)	58	58	58	58	58	58	58	
Emergency bypass								
Channel width (ft)	4	4	4	4	4	4	4	
Electrical room footprint (ft)	25 x 25			25 x 25				

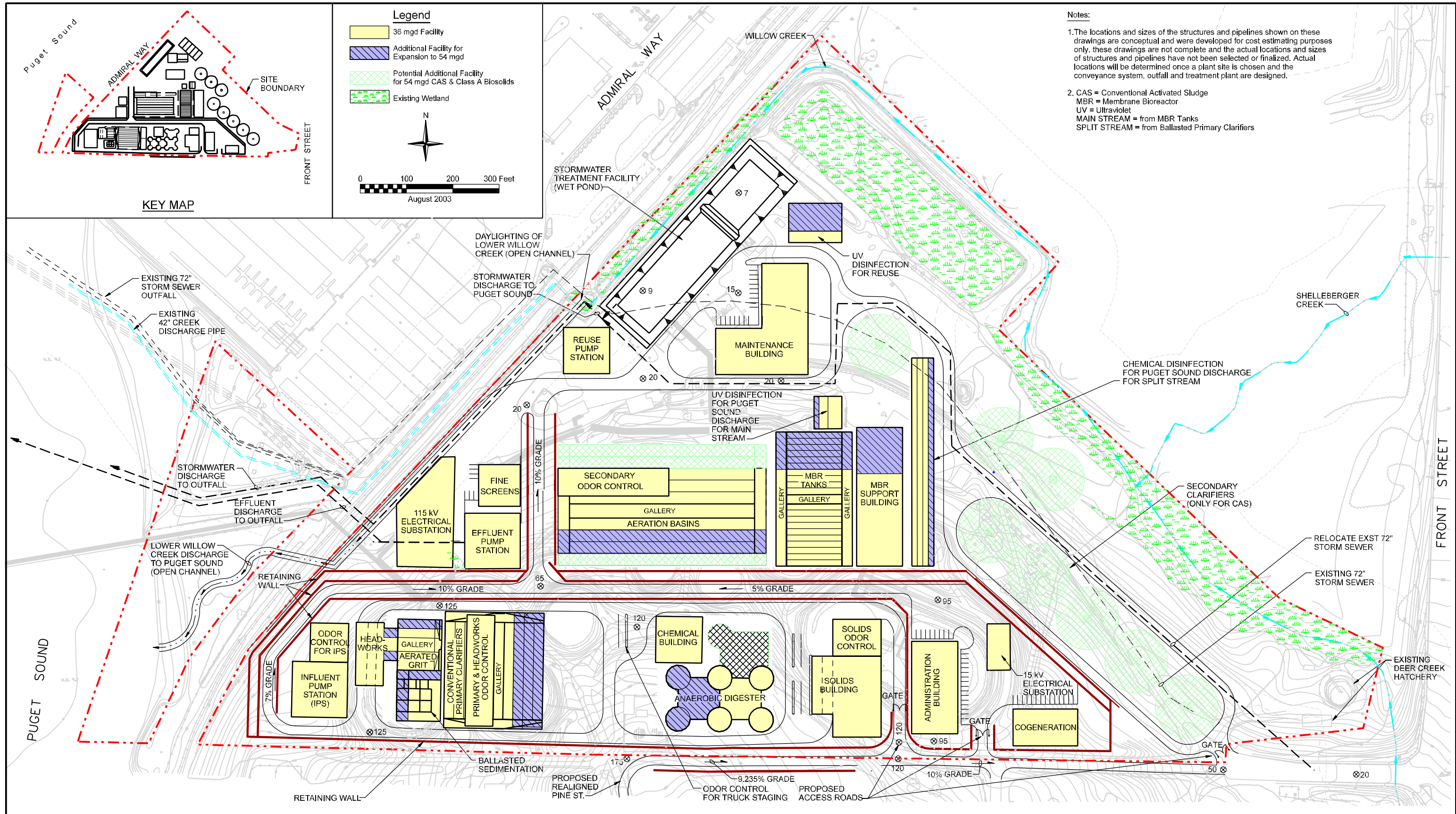
Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
		Rt 9			Unocal			
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Phase 2 - Use 10 mgd modular design								
No. of channels		1	1		1	1	1	
No. of banks per channel		4	4		4	4	4	
No. of modules per bank		26	26		26	26	26	
No. of lamps per module		8	8		8	8	8	
Total no. of UV lamps		832	832		832	832	832	
Minimum channel length (ft)		54	54		54	54	54	
Channel width (inch)		91	91		91	91	91	
Channel maximum depth (inch)		58	58		58	58	58	
No. of 10-mgd modules		5	5		5	5	5	
Electrical room footprint (ft)		60 x 25	60 x 25		60 x 25	60 x 25	60 x 25	
Footprint size including electrical room (ft)	115 x 25	115 x 85	115 x 85	115 x 25	115 x 85	115 x 85	115 x 85	
Effluent Filtration (Granular Media)								Not shown on the layout
Flow rate (mgd)			54				54	
Length x width (ft)			48 x 16				48 x 16	
Total number of units:			16				16	
Number of filters in backwash			1				1	
Number of redundant filters			1				1	
Loading rate at buildout:			3.5 gpm/sf				3.5 gpm/sf	
Footprint size (ft)			120 x 140 x 30				120 x 140 x 30	
Filtration Pump Station								Not shown on the layout
Total Dynamic Head (ft)			20				20	
Flow Rate (mgd)			54				54	
Total number of pumps			6 + 1				6 + 1	
Capacity of pump, mgd each			9				9	
Footprint size (ft)			148 x 40				148 x 40	
Filter Backwash Storage								Not shown on the layout
Air assisted filter backwash rate (gpm/sf)			12				12	
Number of backwashes store water for			3				3	
Number of clean backwash water storage tank			1				1	
Diameter of tank (ft)			80				80	
Depth (ft)			15				15	
Volume of each tank (Mgal)			0.56				0.56	
Footprint size (ft)			84' OD x 16' H				84' OD x 16' H	
Number of waste backwash water storage tank			1				1	
Size, each (ft)			80				80	
Depth (ft)			15				15	
Volume of each tank (Mgal)			0.56				0.56	
Footprint size (ft)			84' OD x 16' H				84' OD x 16' H	
Reuse Water Pump Station								
Total Dynamic Head (TDH) (ft)	300	300	300	450	450	450	450	
Flow Rate (mgd)	5	TBD	TBD	5	TBD	TBD	TBD	
Number of stages	1	1	1	2	2	2	2	
Total number of pumps	3+1	TBD	TBD	2+2	TBD	TBD	TBD	
Capacity of pump, mgd each	1.7	TBD	TBD	5	TBD	TBD	TBD	Phase 1 only; Phase 2 TBD up to 54 mgd
Footprint size of pump station building (ft)	100 x100	100 x100	100 x100	100 x100	100 x100	100 x100	100 x100	Sized for potential ultimate flow of 54 mgd

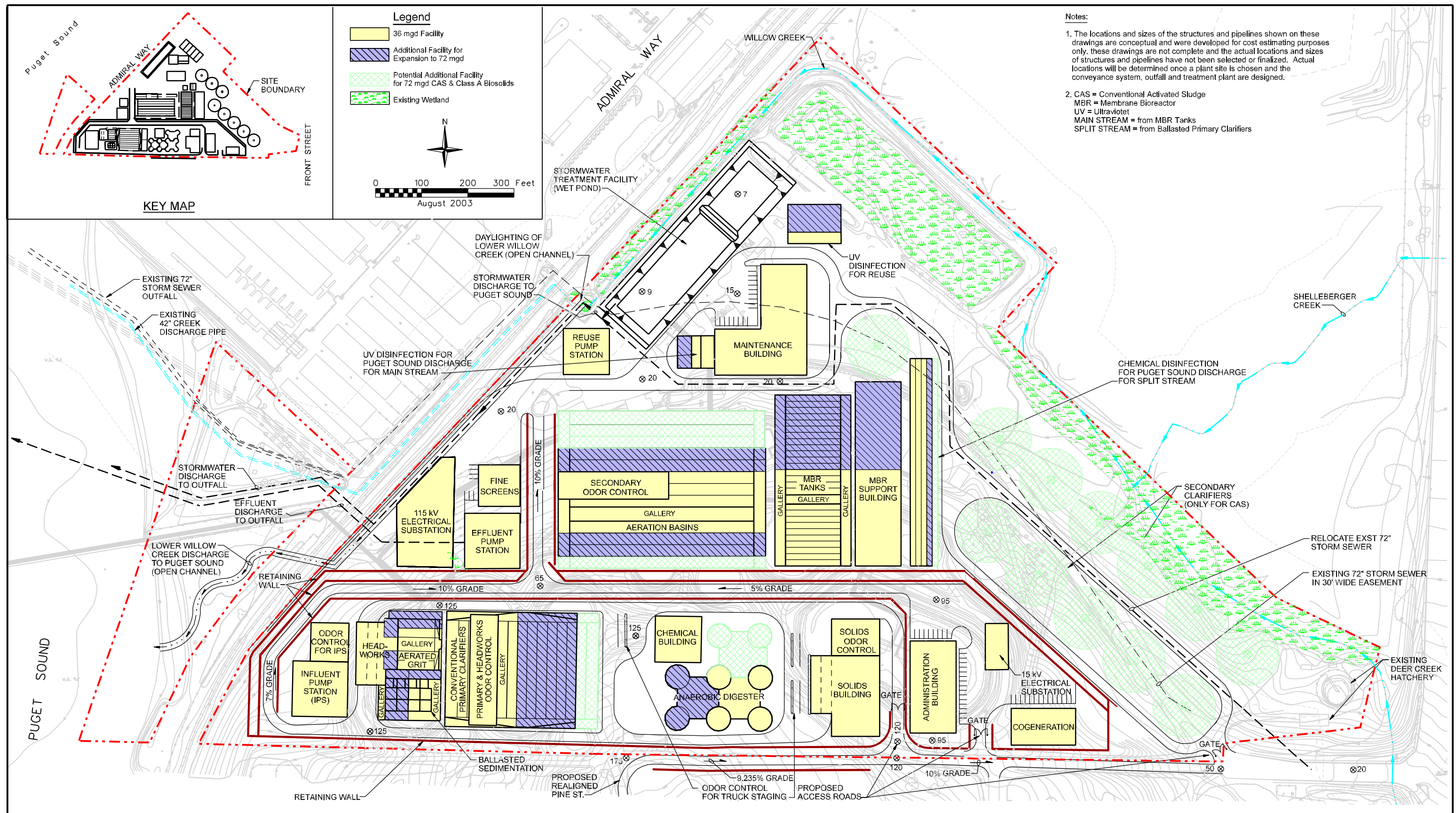
Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
		Rt 9			Unocal			
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Gravity Belt Thickener (in Solids Handling Building)								
Number of meters/unit	2	2	3	2	2	2	3	
Number of units installed	3+1	4+1	4+1	3+1	4+1	5+1	5+1	Includes separate GBT for ballasted sed sludge
GBT Feed Pumps	3+1	4+1	4+1	3+1	4+1	5+1	5+1	Capacity 400 gpm , 40 FT - TDH VFD Drive
Thickened Sludge Pumps	2 +1	3 + 1	3 + 1	2 +1	3 + 1	4 + 1	4 + 1	Capacity 80 gpm 200 ft TDH VFD progressing cavity with 3 stages and low speed. (160 rpm max)
Anaerobic Digester								
Design Total Volume, MG	4.3	6.5	7.6	4.3	6.5	8.6	10.2	
Number of units:	4	6	6	4	6	8	8	Add one tank for Class A for both MBR and CAS for 54 mgd; add two tanks for 72 mgd
Actual volume of each digester (MG):	1.1	1.1	1.3	1.1	1.1	1.3	1.3	
Diameter (ft)	55	55	60	55	55	55	60	
Sidewater depth (ft)	60	60	60	60	60	60	60	
Footprint size, each (ft)	60 OD x 65 H	60 OD x 65 H	65 OD x 65 H	60 OD x 65 H	60 OD x 65 H	60 OD x 65 H	65 OD x 65 H	
Building (ft)	90x90	90x180	90x270	90x90	90x180	90x270	90x270	Assume 3 story building with one story below grade, one at grade, and one elevated. Add 3 story, 100x100 footprint for Class A.
Centrifuge Dewatering (in Solids Handling Building)								
Hour of operation/wk	168	168	168	168	168	168	168	
Number of Units Installed	2 + 1	3 + 1	3 + 1	2 + 1	3 + 1	4 + 1	4 + 1	Assumes 1 additional centrifuge required to meet peak hour sludge flows.
Capture	95%	95%	95%	95%	95%	95%	95%	
Dewatered cake solids content	25%	25%	25%	25%	25%	25%	25%	
Effluent Pump Station								
Total Dynamic Head (TDH) (ft)				75	75	75	75	
Number of stages				1	1	1	1	
Total number of effluent pumps				4 + 1 standby	5 + 1 standby	7 + 1 standby	7 + 1 standby	
Capacity of pump, mgd each				35	35	35	35	
Inside diameter of shaft below ground, ft				100	100	100	100	
Footprint size of pump station building (ft)				130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	130 x 130 x 20 H	
Odor Control								
Three-Stage Chemical Scrubber + carbon (cfm)	40,000	40,000	40,000	40,000	40,000	40,000	40,000	Each train 13' W X 100' L X 21' H. Stack height = 40'. Assume acid + caustic + caustic/hypo stages + carbon polisher.
Influent pump station								
No. of units	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	
Footprint (ft)	85 x 85	85 x 85	85 x 85	85 x 85	85 x 85	85 x 85	85 x 85	
Headworks + primary								
No. of units	4 + 1	5 + 1	5 + 1	4 + 1	5 + 1	6 + 1	6 + 1	1 unit 12,000 cfm. Others 40,000 cfm
Footprint (ft)	240 x 60	240 x 60	240 x 60	240 x 60	240 x 60	240 x 60	240 x 60	
Secondary								
No. of units	4 + 1	5 + 1	6 + 1	4 + 1	5 + 1	6 + 1	7 + 1	
Footprint (ft)								
Aeration basins odor control	130 x 60	130 x 60	130 x 60					
MBR tanks odor control	110 x 60	110 x 60	110 x 60					

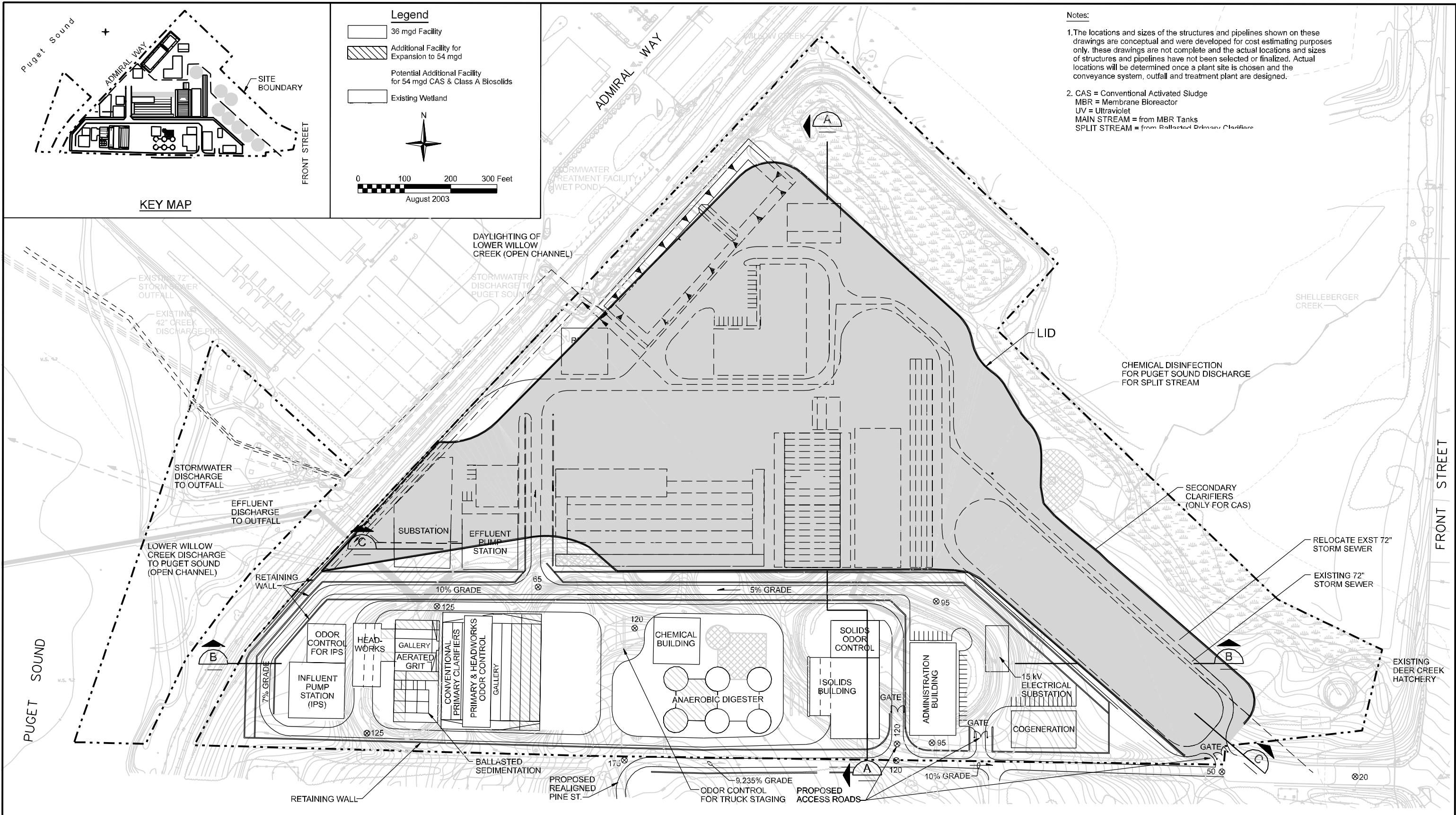
Attachment B								
Brightwater Treatment Plant Design Criteria Summary								
	Rt 9			Unocal				
Facility/Parameter	Ph I MBR	Ph II MBR	Ph II CAS	Ph I MBR	Ph II MBR	72 MBR	72 CAS	Remarks
Aeration basins + MBR tanks				240 x 60	240 x 60	240 x 60	240 x 60	
Solids								
No. of units	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	3 + 1	
Footprint (ft)	105 x 80	105 x 80	105 x 80	105 x 80	105 x 80	105 x 80	105 x 80	
Digester vents								7,200 cfm carbon passive system for vents
No. of units	3	3	3	3	3	3	3	
Digesters								25,000 cfm carbon active system for maintenance
No. of units	2	2	2	2	2	2	2	
Truck staging								1,200 cfm carbon connected to trucks via flexible hose. Assume trucks have rigid gasketed cover.
No. of units	6	6	6	6	6	6	6	
Buildings and Miscellaneous Facilities								
115 kV Electrical substation (ft)	160 x 150	160 x 150	160 x 150	160 x 150	160 x 150	160 x 150	160 x 150	
15 kV Electrical substation (ft)	100 x 50	100 x 50	100 x 50	100 x 50	100 x 50	100 x 50	100 x 50	
Cogeneration for daily power production (biogas)								
Number of units	2	3	TBD	2	3	4	TBD	Replace "Energy self generation"
Capacity, each	3500 kW	2500 - 3500 kW	2500 - 3500 kW	3500 kW	2500 - 3500 kW	2500 - 3500 kW	2500 - 3500 kW	
Footprint (ft)	80 x 140	80 x 140	80 x 140	80 x 140	80 x 140	80 x 140	80 x 140	Assume 2 story building, 15 ft below grade and 20 ft above grade
Diesel Generation								
Number of units	1	2	2	1	2	2	2	
Size	250 kW	250 kW	250 kW	250 kW	250 kW	250 kW	250 kW	
Footprint (ft)	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	18.3 x 7.2 x 9.8 H	Located in cogeneration building
Hot water heating boilers								
Number of units	2	3	3	2	3	4	4	
Capacity, each	250 hp	250 hp	250 hp	250 hp	250 hp	250 hp	250 hp	10 MMBTU
Blower bldg								No additional building. Aeration basin blowers in gallery. Membrane equipment in membrane building.
Chemical buildings	105 x 200 x 20 H	105 x 200 x 20 H	105 x 200 x 20 H	105 x 200 x 20 H	105 x 200 x 20 H	105 x 200 x 20 H	105 x 200 x 20 H	Combined chemical storage and feed bldg for both disinfection systems, odor control, and ballasted sed
Solids building (Thickening/Dewatering)	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	175 x 105 x 60 H plus 45 x 125 x 60H	L shaped bldg.; includes 2 enclosed truck loading bays
Maintenance	200 x 100 x 30 H	200 x 100 x 30 H	200 x 100 x 30 H	200 x 100 x 20 H plus 100 x 140 x 20H	200 x 100 x 20 H plus 100 x 140 x 20H	200 x 100 x 20 H plus 100 x 140 x 20H	200 x 100 x 20 H plus 100 x 140 x 20H	At Route 9, 2/3 of the maintenance building has two stories, the other third has one story. At Unocal entire building is in one story in an L shape configuration.
Administration, Lab, Locker, etc	200 x 100 x 20 H	200 x 100 x 20 H	200 x 100 x 20 H	200 x 100 x 20 H	200 x 100 x 20 H	200 x 100 x 20 H	200 x 100 x 20 H	
Covered parking for maintenance vehicles	40 x 80	40 x 80	41 x 80	42 x 80	43 x 80	44 x 80	45 x 80	Carport type facility
Laydown/boneyard	70 x 120	70 x 120	71 x 120	72 x 120	73 x 120	74 x 120	75 x 120	Half covered and half open

Attachment C – Layouts









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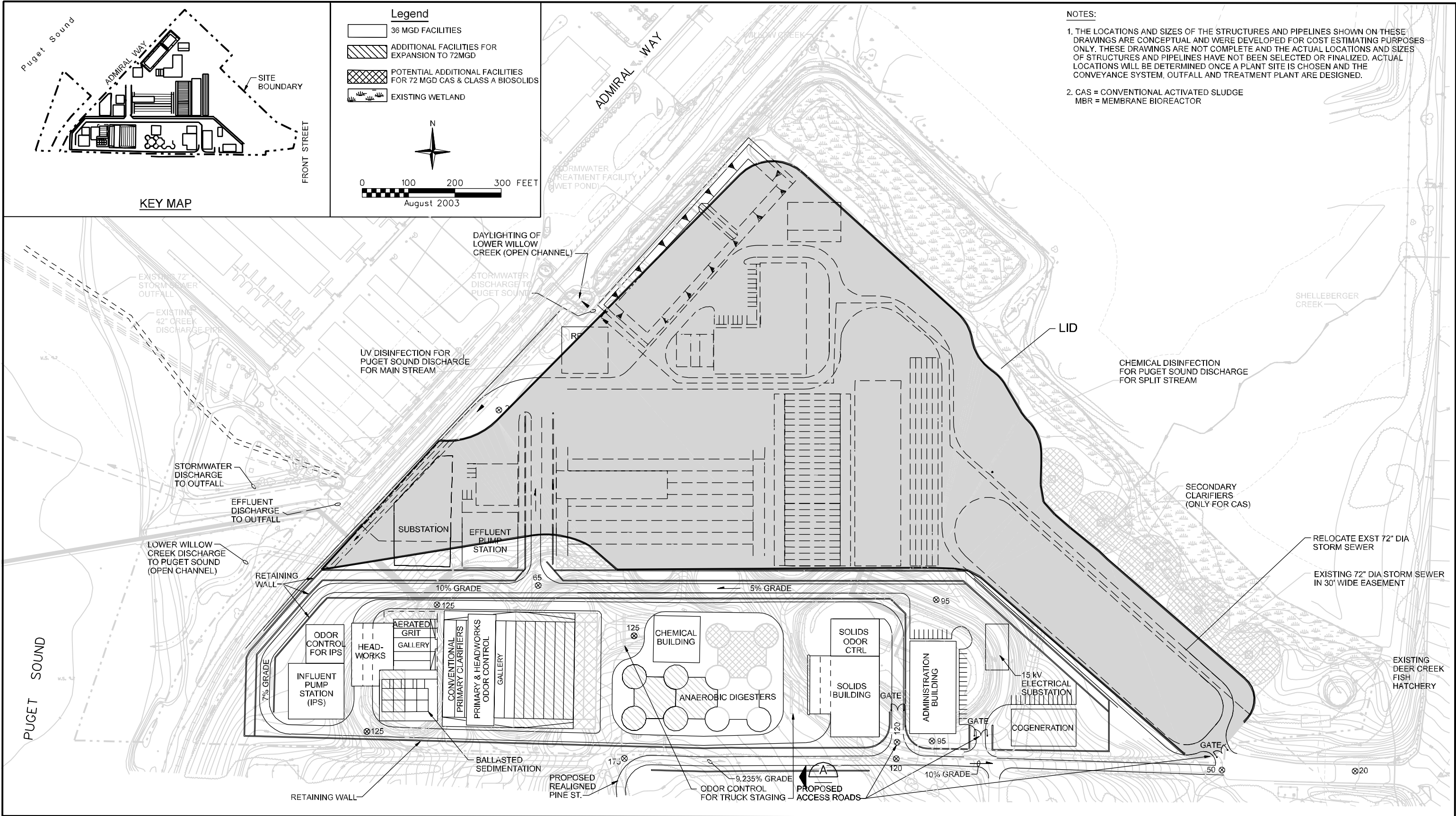


Figure C-5
Unocal - 36 and 72 mgd Plant with Multi-Modal Lid
*BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM*

SEA NDM/173243

Attachment D – Sections



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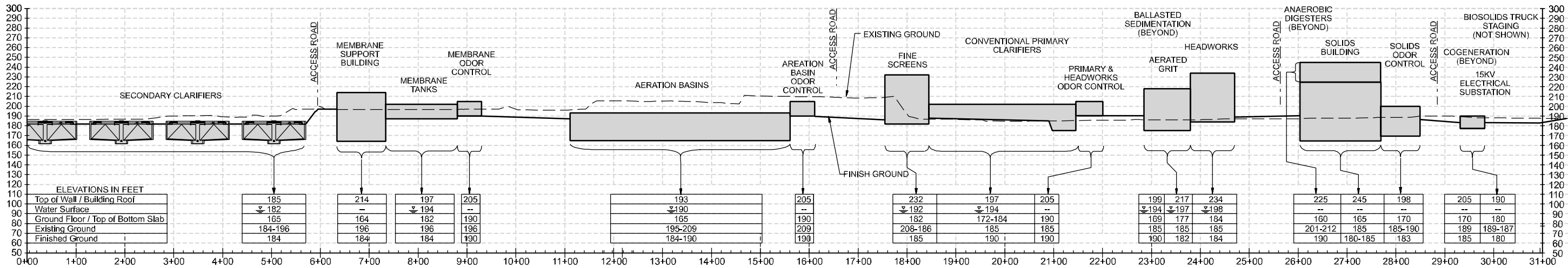
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File Name: tm033f06.dgn 16-Aug-2003 07:24:40

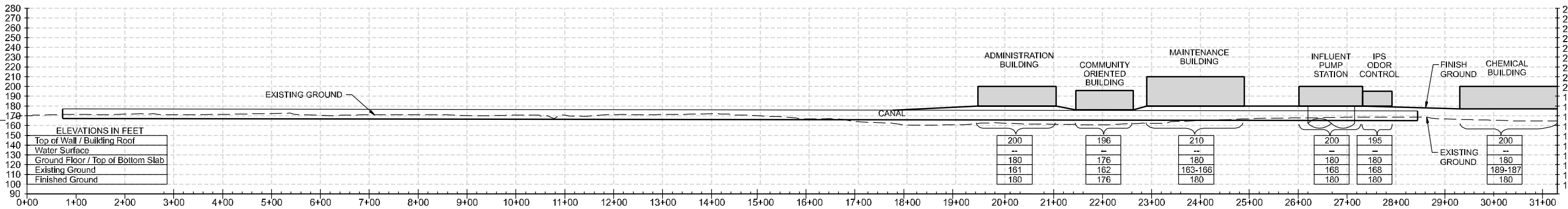
NOTES:

1. THE LOCATIONS AND SIZES OF THE STRUCTURES AND PIPELINES SHOWN ON THESE DRAWINGS ARE CONCEPTUAL AND WERE DEVELOPED FOR COST ESTIMATING PURPOSES ONLY. THESE DRAWINGS ARE NOT COMPLETE AND THE ACTUAL LOCATIONS AND SIZES OF STRUCTURES AND PIPELINES HAVE NOT BEEN SELECTED OR FINALIZED. ACTUAL LOCATIONS WILL BE DETERMINED ONCE A PLANT SITE IS CHOSEN AND THE CONVEYANCE SYSTEM, OUTFALL AND TREATMENT PLANT ARE DESIGNED.

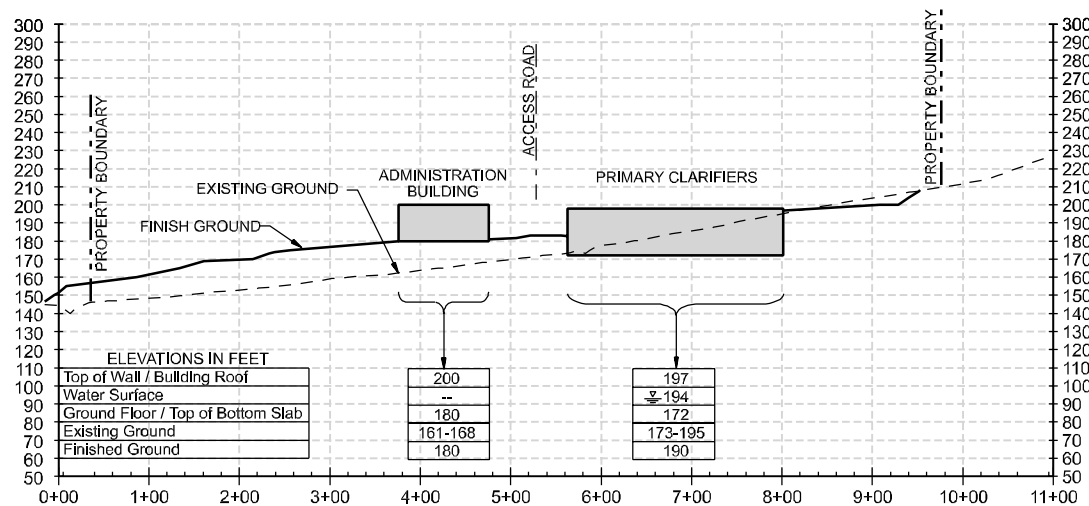
2. CAS = CONVENTIONAL ACTIVATED SLUDGE MBR = MEMBRANE BIOREACTOR



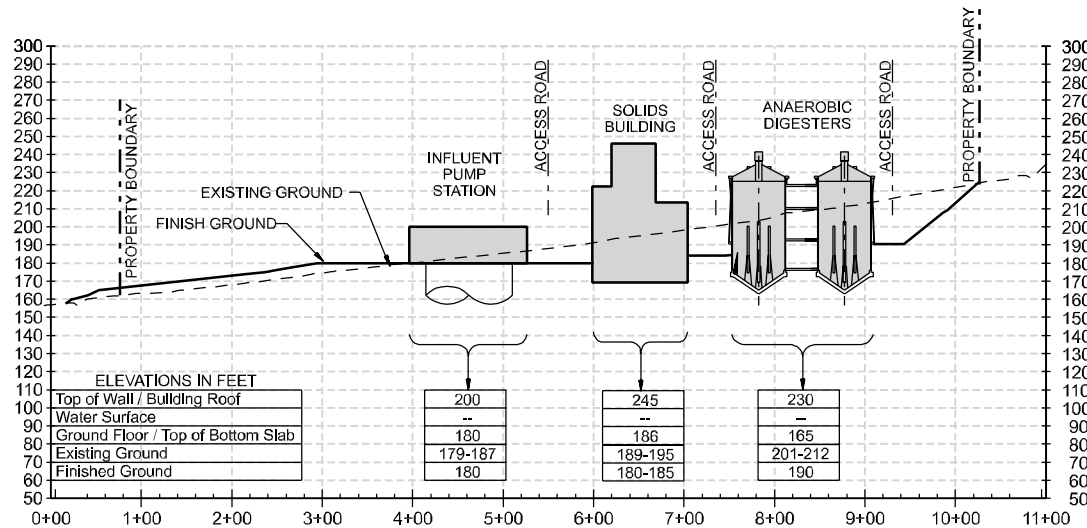
SECTION A
1"=200' HORIZ; 1"=100' VERT.



SECTION B
1"=200' HORIZ; 1"=100' VERT.

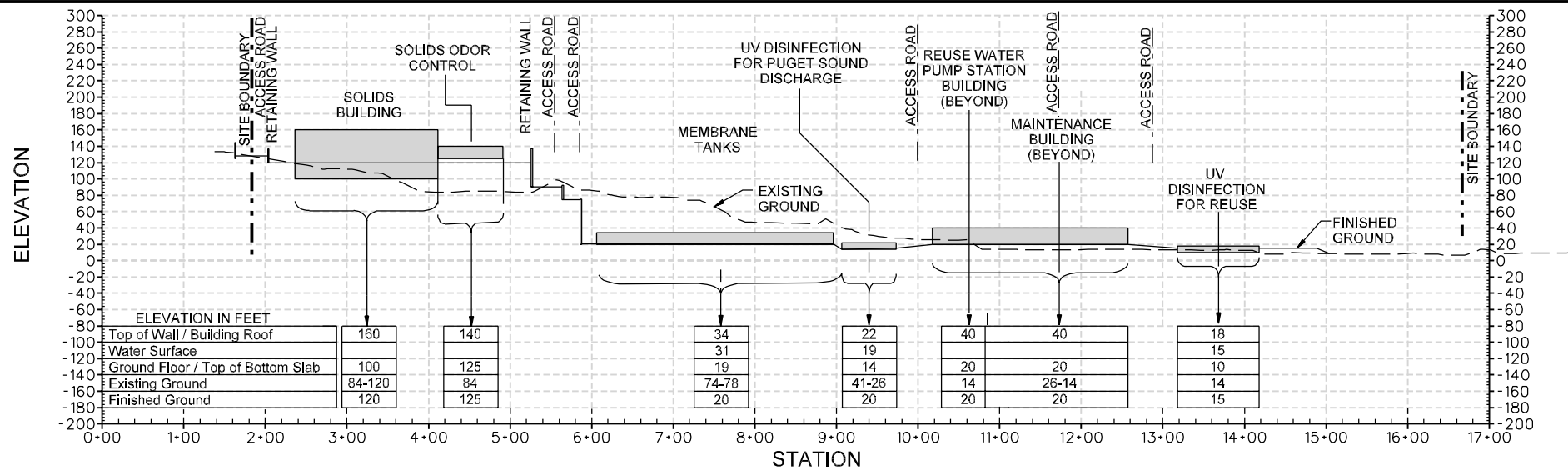


SECTION C
1"=200' HORIZ; 1"=100' VERT.



SECTION D
1"=200' HORIZ; 1"=100' VERT.

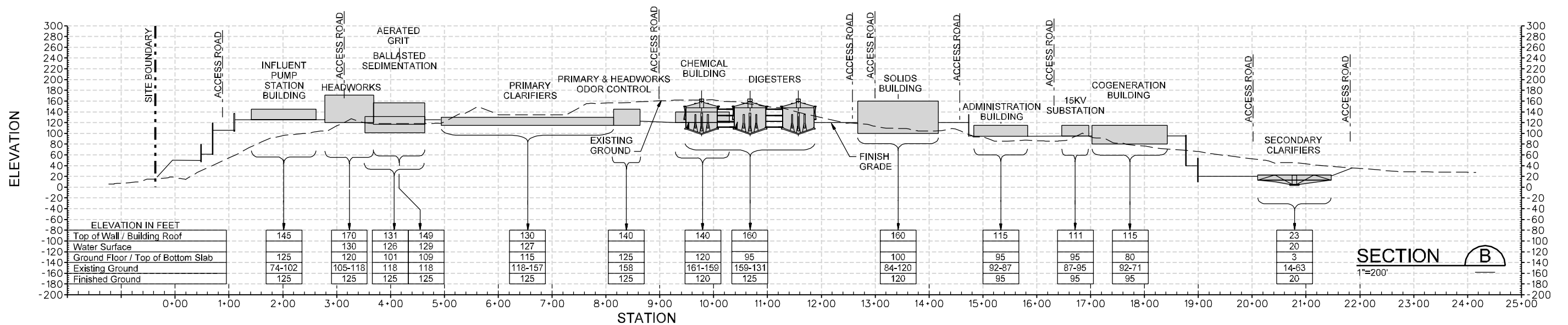
Figure D-1
Route 9 - 54 mgd Plant Sections
**BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM**



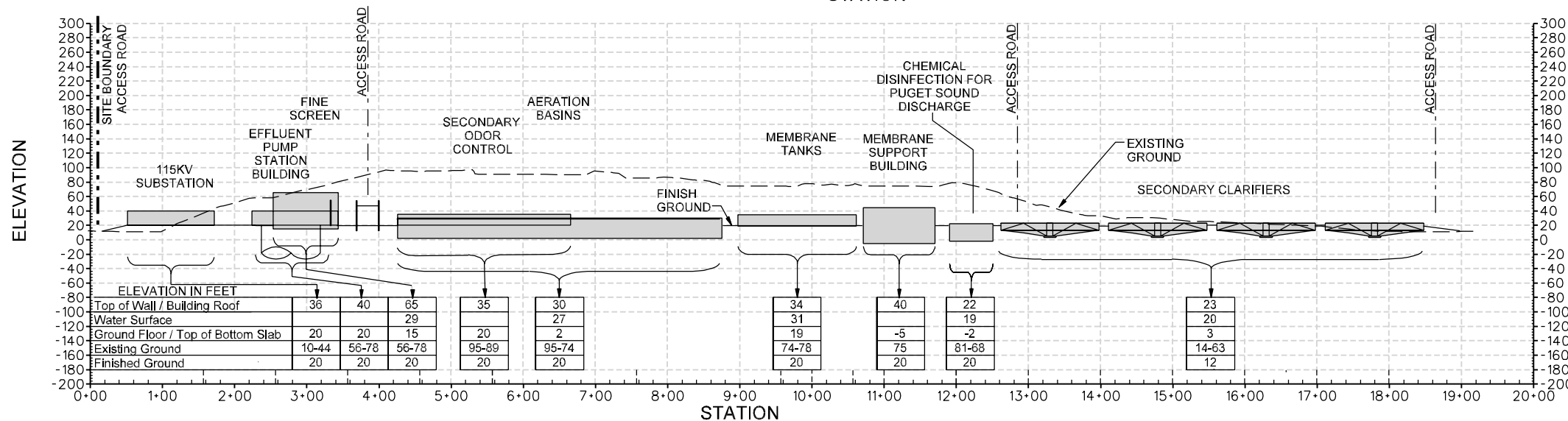
NOTE:

1. THE LOCATIONS AND SIZES OF THE STRUCTURES AND PIPELINES SHOWN ON THESE DRAWINGS ARE CONCEPTUAL AND WERE DEVELOPED FOR COST ESTIMATING PURPOSES ONLY. THESE DRAWINGS ARE NOT COMPLETE AND THE ACTUAL LOCATIONS AND SIZES OF STRUCTURES AND PIPELINES HAVE NOT BEEN SELECTED OR FINALIZED. ACTUAL LOCATIONS WILL BE DETERMINED ONCE A PLANT SITE IS CHOSEN AND THE CONVEYANCE SYSTEM, OUTFALL AND TREATMENT PLANT ARE DESIGNED.
2. POSSIBLE WALK-IN BUILDINGS ABOVE PRIMARY CLARIFIERS, AERATION BASINS MEMBRANE TANKS AND SECONDARY CLARIFIERS ARE NOT SHOWN.

SECTION A
1"=200'



SECTION B
1"=200'



SECTION C
1"=200'



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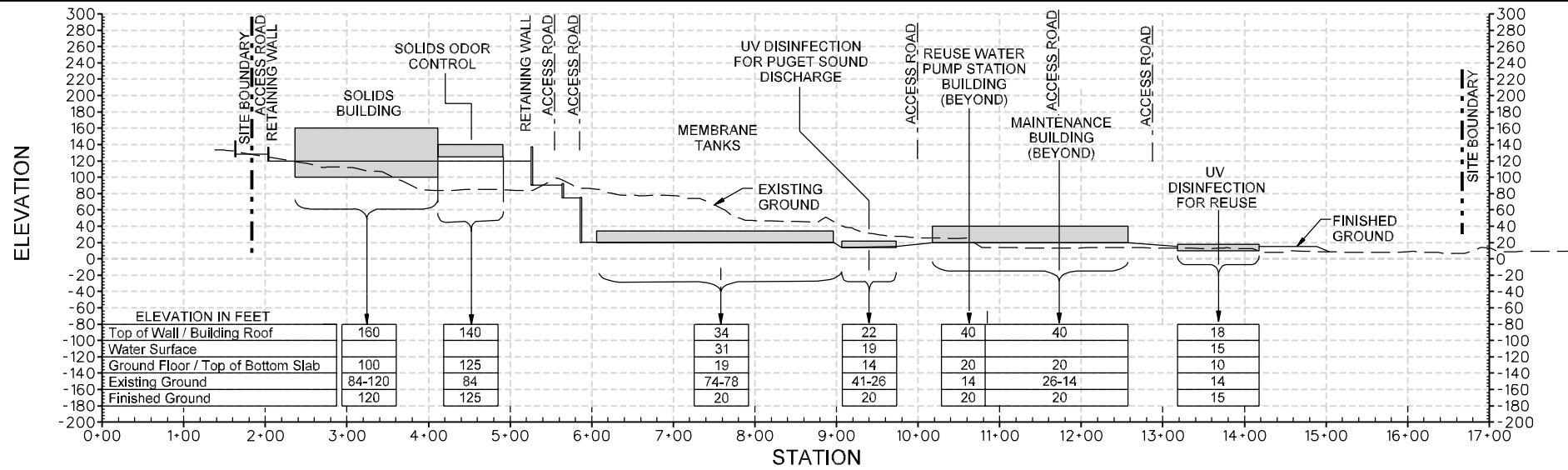
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Figure D-2

Unocal - 54 mgd Plant Sections

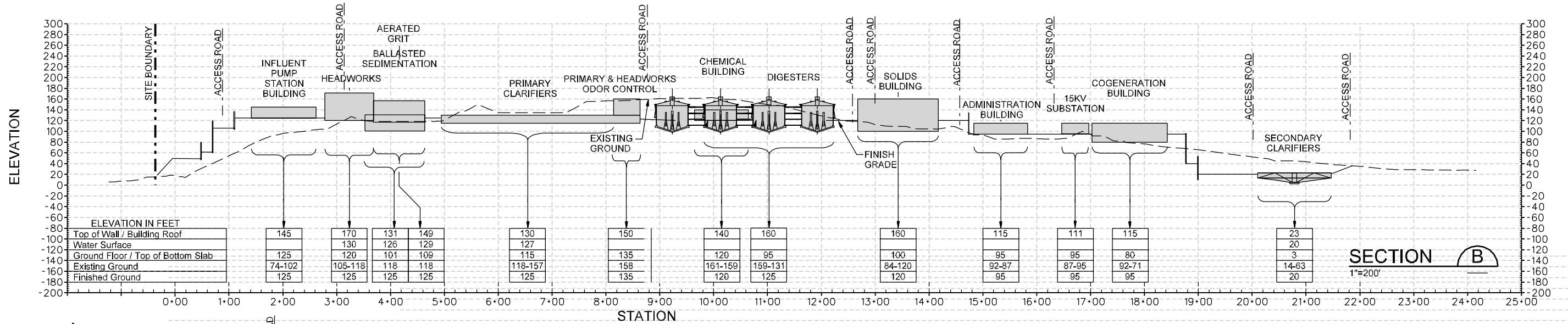
**BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM**



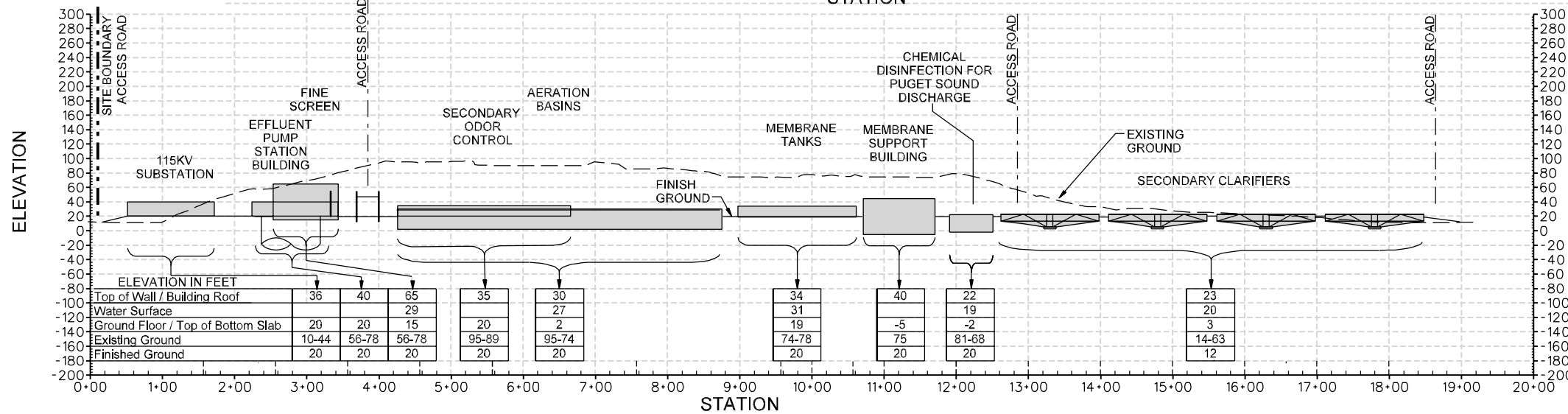
NOTE:

1. THE LOCATIONS AND SIZES OF THE STRUCTURES AND PIPELINES SHOWN ON THESE DRAWINGS ARE CONCEPTUAL AND WERE DEVELOPED FOR COST ESTIMATING PURPOSES ONLY. THESE DRAWINGS ARE NOT COMPLETE AND THE ACTUAL LOCATIONS AND SIZES OF STRUCTURES AND PIPELINES HAVE NOT BEEN SELECTED OR FINALIZED. ACTUAL LOCATIONS WILL BE DETERMINED ONCE A PLANT SITE IS CHOSEN AND THE CONVEYANCE SYSTEM, OUTFALL AND TREATMENT PLANT ARE DESIGNED.
2. POSSIBLE WALK-IN BUILDINGS ABOVE PRIMARY CLARIFIERS, AERATION BASINS MEMBRANE TANKS AND SECONDARY CLARIFIERS ARE NOT SHOWN.

SECTION A
1"=200'



SECTION B
1"=200'



SECTION C
1"=200'

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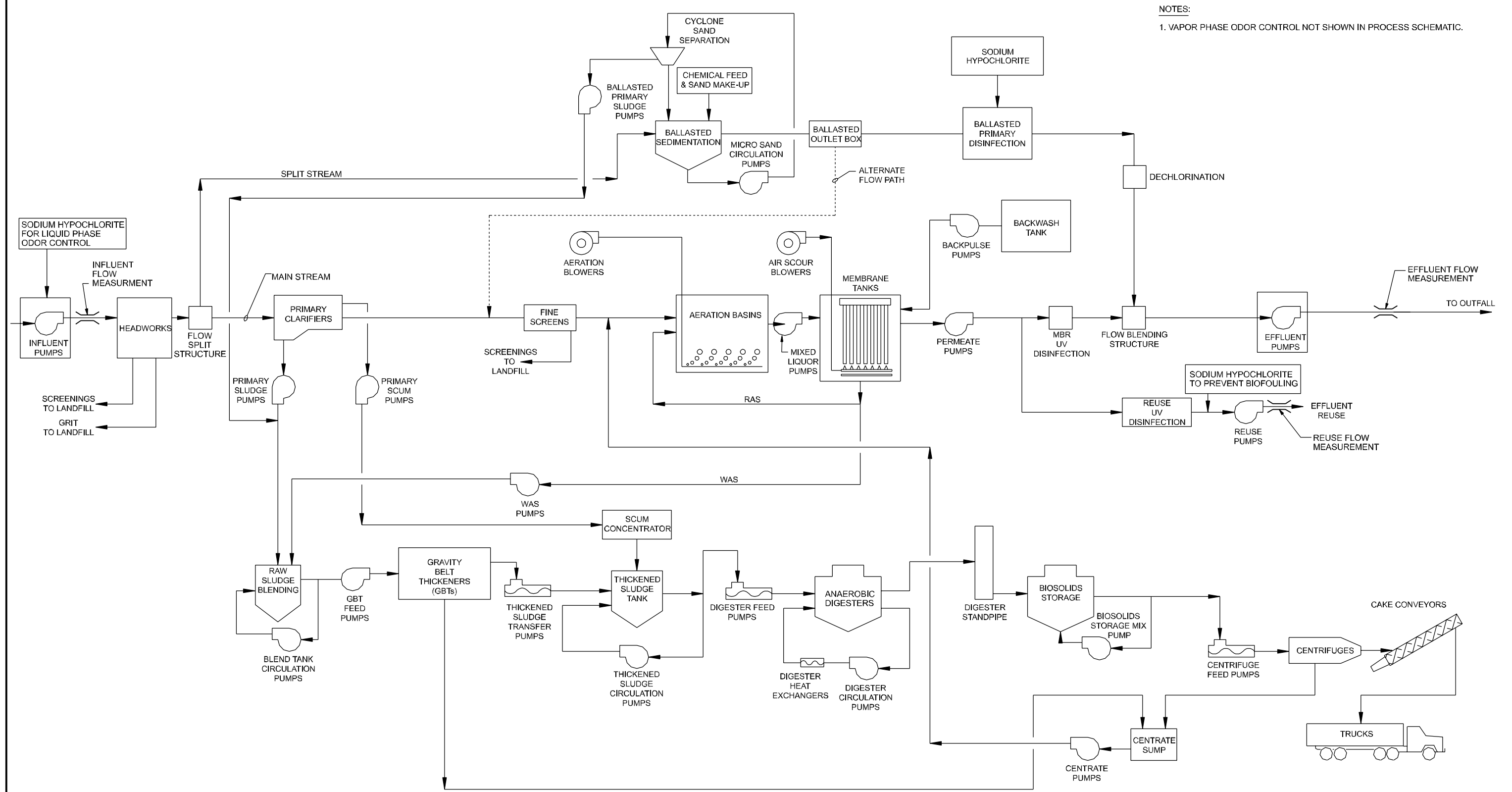
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Attachment E – Process Flow Schematics

SEA NDM/173243

Figure E-2
Treatment Process Schematic for Unocal Site
*BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM*



Attachment F – Plant Site Areas

117.6 Acres
Less New R.O.W. 5.0 Acres
= 112.6 Acres

1.6 Acres
New R.O.W.

RURAL
RESIDENTIAL
AREA = 37.3 Acres

URBAN
GROWTH
BOUNDARY

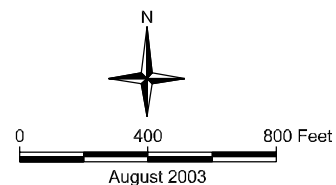
STATE ROUTE ROUTE 9

RAILROAD RIGHT-OF-WAY

1.7 Acres

3.4 Acres
New R.O.W.

Total New Area
of All Parcels
 $112.6 + 1.7$
= 114.3 Acres



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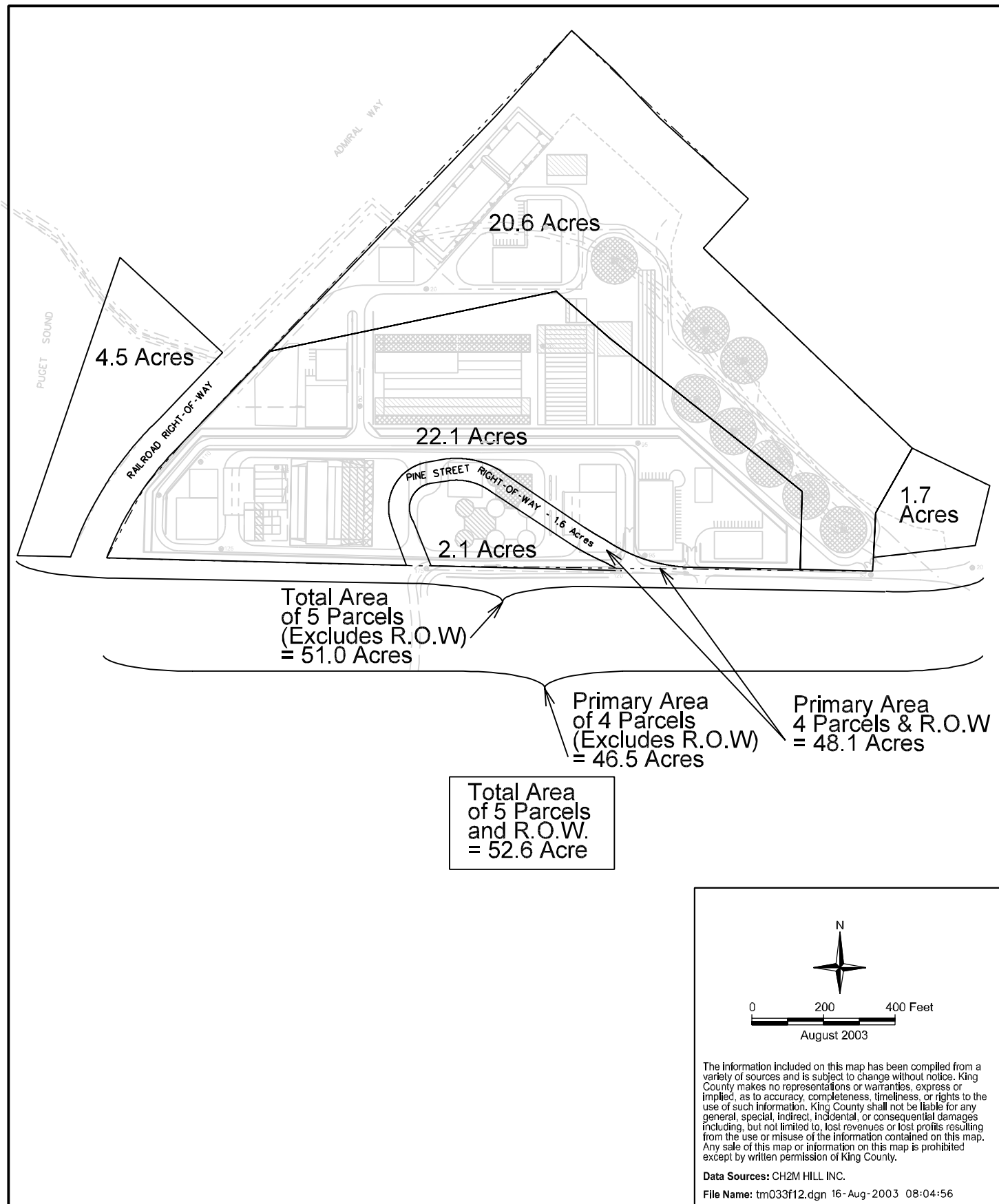
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Figure F-1
Route 9 - Property Boundary Areas
**BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM**

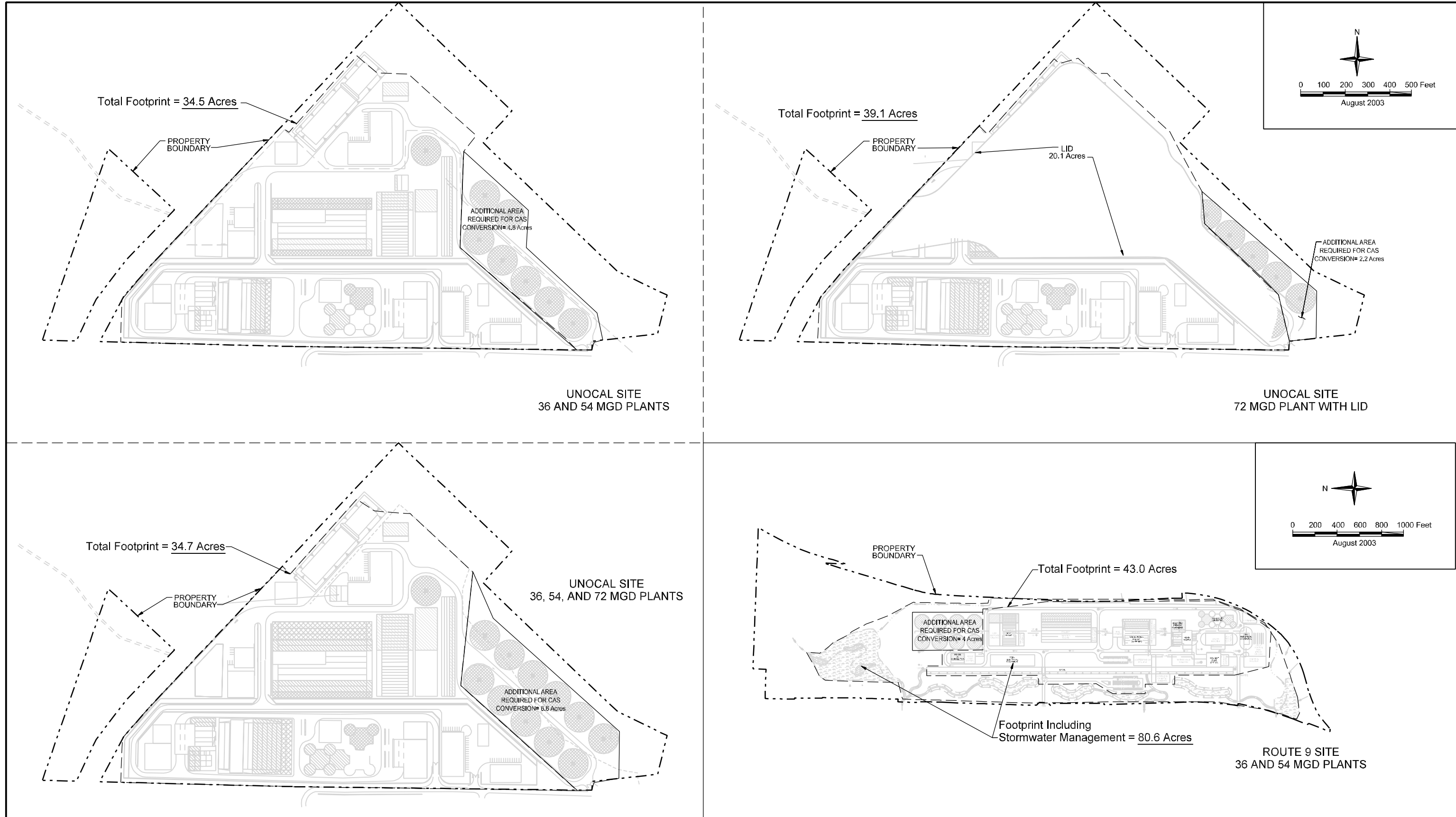


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Figure F-2
Unocal - Property Boundary Areas
**BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM**



SEA NDM/173243

Figure F-3
**Footprint (Areas Occupied by Treatment and Support Facilities)
 for 36 mgd, 54 mgd and 72 mgd Plant, Unocal and Route 9 Sites**
*BRIGHTWATER REGIONAL
 WASTEWATER TREATMENT SYSTEM*

Attachment G – Energy Requirements

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

INFLUENT PUMPING				EFFLUENT PUMPING				PRELIMINARY TREATMENT				GRIT REMOVAL			
Ph I MBRPh II MBR72 MBR				Ph I MBRPh II MBR72 MBR				Ph I MBRPh II MBR72 MBR				Ph I MBRPh II MBR72 MBR			
Route 9 Influent Pump (two-stage)				Unocal Effluent Pump				Raw Sewage Screening				Vortex Grit Chamber			
No.	8+2	10+2		TDH	75	75	75	No.	4+2	6+2	8+2	No.	2+1	3+1	4+1
TDH	240	240		No.	4+1	5+1	7+1	hp/each	1	1	1	Diameter, ft/each	24	24	24
type	Vertical, non-clog centrifugal			type	Vertical, non-clog centrifugal			total hp	4	6	8	hp/each	2	2	2
hp/each	1,500	1,500		hp/each	900	900	900	Screening conveyor				total hp	4	6	8
total hp	15,000	18,000		total hp	4,500	5,400	7,200	No.	1+1	2+1	2+1	Grit Pumping			
Unocal - Tunneled Forcemain Influent Pump				Route 9 Does not require effluent pumping				type	screw			No.	4+2	6+2	8+2
TDH	140	140	140					hp/each	5	5	5	hp/each	20	20	20
No.	4+1	5+1	7+1					total hp	5	10	10	total hp	80	120	160
type	Vertical, non-clog centrifugal							Screening washer/press				Grit Washing			
hp/each	1,500	1,500	1,500					No.	2	3	4	No.	2+1	3+1	4+1
total hp	7,500	9,000	12,000					type	screw			Type	Snail classifier		
								hp/each	0.75	0.75	0.75	hp/each	2	2	2
								total hp	1.5	2.25	3	total hp	4	6	8
								Hypo Injector Booster Pump for Prechlorination				Grit and Screening Building Supply Fan			
								No.	1+1	1+1	1+1	No.	4	4	4
								hp/each	25	25	25	hp/each	10	10	10
								total hp	25	25	25	total hp	40	40	40
								capacity, gpm	400	400	400				
								Hypo Metering Pump				Aerated Grit			
								No.	1+1	1+1	1+1	No.	3	4	5
								hp/each	0.75	0.75	0.75	Length x width (ft)	60 x 20	60 x 20	60 x 20
								total hp	0.75	0.75	0.75	Grit Aeration Blowers			
												No.	2+1	3+1	4+1
												Capacity	1200 scfm	1200 scfm	1200 scfm
												hp/each	40	40	40
												total hp	70	105	160
												Grit Pumping			
												No.	9	15	18
												Capacity	100 gpm	100 gpm	100 gpm
												hp/each	20	20	20
												total hp	180	300	360
												Grit Washing			
												No.	3	4	5
												Type	Snail classifier		
												hp/each	2	2	2
												total hp	6	8	10
												Grit and Screening Building Supply Fan			
												No.	4	4	4
												hp/each	10	10	10
												total hp	40	40	40
												Vortex Grit	128	172	216
												Aerated Grit	296	453	570
Subtotal hp (for each process)															
Both sites															
Unocal	7,500	9,000	12,000	Unocal	4500	5400	7200								
Route 9	15,000	18,000		Route 9	0	0									

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

PRIMARY SEDIMENTATION				BALLASTED SEDIMENTATION				AERATION BASIN			
	Ph I MBR	Ph II MBR	72 MBR		Ph I MBR	Ph II MBR	72 MBR		Ph I MBR	Ph II MBR	72 MBR
Primary Clarifier				No. of Train				No.			
No.	6	9	12	2	3	4		4	6	8	
Size, ft/each	200 x 20	200 x 20	200 x 20								
Chain & Flight Sludge Collector				Equipment for each train				Aeration Blowers			
No.	6	9	12	Injection Tank Mixer				No.	4+1	6+1	8+1
hp/each	0.5	0.5	0.5	hp, each	15	15	15	capacity, each	15000 cfm	15000 cfm	15000 cfm
total hp	3	4.5	6	total hp	15	15	15	hp, each	500	500	500
Sludge Pump				Maturation Tank Mixer				total hp	2000	3000	4000
No.	6+3	9+5	12+6	hp, each	25	25	25				
Type	Recessed impeller centrifugal pump			total hp	25	25	25				
Capacity	100 gpm	100 gpm	100 gpm	Microsand Pumps							
hp/each	15	15	15	No., each unit	1+1	1+1	1+1				
total hp	90	135	180	Capacity, each	620 gpm	620 gpm	620 gpm				
Scum skimmer				hp, each	40	40	40				
No.	6	9	12	total hp	40	40	40				
Type	Helic screw			Polymer/Coagulant System							
hp/each	1	1	1	Mixer							
total hp	6	9	12	no.	1	1	1				
Scum Pump				hp, each	2	2	2				
No.	4	4	4	total hp	2	2	2				
type	progressing cavity			Polymer Metering Pumps							
hp/each	15	15	15	no.	3+1	3+1	3+1				
total hp	60	60	60	Capacity	625 gph	625 gph	625 gph				
Decant pump				hp, each	1	1	1				
No.	4	4	4	total hp	3	3	3				
type	centrifugal pump			Coagulant Metering Pumps							
hp/each	5	5	5	no.	2+1	2+1	2+1				
total hp	20	20	20	Capacity	318 gph	318 gph	318 gph				
Clarifier Dewatering pump				hp, each	0.5	0.5	0.5				
No.	2	2	2	total hp	1	1	1				
hp/each	50	50	50	Ballasted Sedimentation Sludge Pumps							
total hp	100	100	100	no.	2+1	3+1	4+1				
Scum Heat Exchanger, Hot Water Circ Pumps				capacity, each	620 gpm	620 gpm	620 gpm				
No.	2	2	2	hp, each	15	15	15				
hp/each	1.5	1.5	1.5	total hp	30	45	60				
total hp	3	3	3								
Fine Screen (2mm)											
No.	3+1	4+1	6+1								
hp/each	5	5	5								
total hp	15	20	30								
Subtotal hp (for each process)											
Both sites	297	352	411	202	303	404		2000	3000	4000	
Unocal											
Route 9											

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

MBR PROCESS (Equipment and Power Estimates from Zenon Proposal on March 21,2003)				CHEMICAL DISINFECTION			
Ph I MBR		MBR Process (Continued)		For Puget Sound discharge			
				Ph I MBR		Ph II MBR	72 MBR
				Disinfection Blending/Mixing Box			
				No.	2	2	
				Size, ft/each	20 x 20	20 x 20	
				Mechanical Mixer			
				No.	3	4	5
				hp/each	25	25	25
				total hp	75	100	125
				Hypo Injector Booster Pump			
				No.	1+1	1+1	1+1
				hp/each	25	25	25
				total hp	25	25	25
				capacity, gpm	400	400	400
				Hypo Metering Pump			
				No.	1+1	1+1	1+1
				hp/each	0.75	0.75	0.75
				total hp	0.75	0.75	0.75
				Bisulfite Injector Booster Pump			
				No.	1+1	1+1	1+1
				hp/each	25	25	25
				total hp	25	25	25
				capacity, gpm	400	400	400
				Bisulfite Metering Pump			
				No.	1+1	1+1	1+1
				hp/each	0.75	0.75	0.75
				total hp	0.75	0.75	0.75

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

UV DISINFECTION						REUSE PRODUCT WATER PUMPING		CHEMICAL STORAGE AND FEED SYSTEMS IN SOLIDS HANDLING					
For Puget Sound discharge (at Unocal)				For reuse									
	Ph I MBR	Ph II MBR	72 MBR	Ph I MBR	Ph II MBR & 72 MBR		Ph I MBR	Ph II MBR & 72 MBR		Ph I MBR	Ph II MBR	72 MBR (Unocal Only)	

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

SLUDGE THICKENING				ANAEROBIC DIGESTERS				DEWATERING			
	Ph I MBR	Ph II MBR	72 MBR (Unocal Only)		Ph I MBR	Ph II MBR	72 MBR (Unocal Only)		Ph I MBR	Ph II MBR	72 MBR (Unocal Only)
Gravity Belt Thickeners				Digesters				Centrifuges			
No.	3+1	4+1	5+1	No.	4	6	8	No.	2+1	3+1	4+1
hp/each	10	10	10					hp/each	150	150	150
total hp	30	40	50					total hp	300	450	600
Raw Sludge Blend Tank Air Blower				Digester Feed Pumps				Centrifuge Feed Pumps			
No.	1	2	2	No.	4+2	6+3	8+4	No.	2+1	3+1	4+1
hp/each	30	30	30	hp/each	50	50	50	hp/each	15	15	15
total hp	30	60	60	total hp	200	300	400	total hp	30	45	60
GBT Feed Pumps				Sludge Circulation Pumps				Sludge Conveyors			
No.	3+1	4+1	5+1	No.	4	6	8	No.	2	2	2
hp/each	20	20	20	hp/each	50	50	50	hp/each	40	40	40
total hp	60	80	100	total hp	200	300	400	total hp	80	80	80
Sludge Thickening Bypass Pump				Digester Mixing Systems				Sludge Conveyors			
No.	1	1	1	No.	4	6	8	No.	4	4	4
hp/each	30	30	30	hp/each	45	45	45	hp/each	5	5	5
total hp	30	30	30	total hp	180	270	360	total hp	20	20	20
Gravity Belt Washwater Booster Pump				Digester Auxiliary Sludge Circulation Pumps				Digested Sludge Grinders			
No.	3+1	4+1	5+1	No.	4	6	8	No.	1+1	1+1	1+1
hp/each	10	10	10	hp/each	25	25	25	hp/each	15	15	15
total hp	30	40	50	total hp	100	150	200	total hp	15	15	15
Thickened Sludge Pumps				Gas Dome Pumps				Centrate Equalization Tank Mix Pumps			
No.	2+1	3+1	4+1	No.	4	6	8	No.	1+1	2+1	2+1
hp/each	25	25	25	hp/each	30	30	30	hp/each	25	25	25
total hp	50	75	100	total hp	120	180	240	total hp	25	50	50
Thickened Sludge Blend Tank Mixer				Digested Biosolids Storage Mixing Pumps				Centrate Transfer Pumps			
No.	1	2	2	No.	3	3	3	No.	1+1	2+1	2+1
hp/each	15	15	15	hp/each	30	30	30	hp/each	20	20	20
total hp	15	30	30	total hp	90	90	90	total hp	20	40	40
				Hot Water System Pumps							
				No.	4	4	4				
				hp/each	20	20	20				
				total hp	80	80	80				
Subtotal hp (for each process)											
Both sites	245	355	420		970	1370	1770		490	700	865
Unocal											
Route 9											

Attachment G Brightwater Wastewater Treatment Plant Energy Requirements
Table G-1 Equipment List

COGENERATION AND HEAT RECOVERY HOT WATER SYSTEM				ODOR CONTROL				ODOR CONTROL (Continued)			
	Ph I MBR	Ph II MBR	72 MBR (Unocal Only)		Ph I MBR	Ph II MBR	72 MBR (Unocal Only)		Ph I MBR	Ph II MBR	72 MBR (Unocal Only)
Cogeneration Engine Generator Set				Scrubber recirculation pumps				Chemical metering pumps			
	No.			Influent pump station				Influent pump station			
				No.	3+1	3+1	3+1	No.	4+4	4+4	4+4
				hp, each	50	50	50	hp, each	0.5	0.5	0.5
				total hp	150	150	150	total hp	2	2	2
Digester Gas Fuel Consumption/each	1+1	2+1	2+1	Preliminary + primary				Preliminary + primary			
	300-400 scfm	300-400 scfm	300-400 scfm	No.	4+1	5+1	6+1	No.	4+4	4+4	4+4
	Output/each	1,000 kw	1,000 kw	hp, each	75	75	75	hp, each	0.5	0.5	0.5
	Heat Recovered/each	5.5 million BTU/hr	5.5 million BTU/hr	total hp	300	375	450	total hp	2	2	2
Primary Hot Water Circ. Pump				Secondary				Secondary			
	No.			No.	4+1	5+1	6+1	No.	4+4	4+4	4+4
	hp/each			hp, each	75	75	75	hp, each	0.5	0.5	0.5
	total hp			total hp	300	375	450	total hp	2	2	2
Secondary Treatment Hot Water Circ. Pump				Solids				Solids			
	No.			No.	3+1	3+1	3+1	No.	4+4	4+4	4+4
	hp/each			hp, each	50	50	50	hp, each	0.5	0.5	0.5
	total hp			total hp	150	150	150	total hp	2	2	2
Digester Hot Water Circ. Pump				Exhaust Fans							
	No.			Influent pump station							
	hp/each			No.	3+1	3+1	3+1				
	total hp			hp, each	200	200	200				
Boilers				total hp	600	600	600				
	No.			Preliminary + primary							
	hp/each			No.	4+1	5+1	6+1				
	total hp			hp, each	200	200	200				
				total hp	800	1000	1200				
				Secondary							
				No.	5	5+1	6+1				
				hp, each	200	200	200				
				total hp	800	1000	1200				
				Solids							
				No.	3+1	3+1	3+1				
				hp, each	200	200	200				
				total hp	600	600	600				
				Digesters							
				No.	2	2	2				
				hp, each	50	50	50				
				total hp	100	100	100				
				Truck staging							
				No.	10	10	10				
				hp, each	6	6	6				
				total hp	60	60	60				
Subtotal hp (for each process)											
Both sites	130	195	195								
Unocal											
Route 9											

Attachment G
Brightwater Wastewater Treatment Plant Energy Requirements
Table G-2 Real Power Demand

Edmonds Unocal Site

	36/130 mgd (year 2010)			54/170 mgd (year 2040)			72/235 mgd (year 2040)		
Unit: kW	Connected Load ¹	Peak Demand ²	Average Demand ³	Connected Load ¹	Peak Demand ²	Average Demand ³	Connected Load ¹	Peak Demand ²	Average Demand ³
Influent and Effluent Pump Station ⁴	11,200	9,000	1,700	13,400	10,700	2,000	17,900	14,300	2,700
Plant w/ Split MBR Treatment ⁵	11,300	9,000	5,700	15,500	12,400	7,800	19,600	15,700	9,800
Plant w/ Ballasted Sedimentation ⁷	270	220	200	370	300	280	480	380	360
Reuse (w/UV disinfection) ^{5 & 6}	600	480	300	6,400	5,100	3,200	6,400	5,100	3,200
Total Plant + Influent Pump Station + Effluent Pump Station + Reuse	23,370	18,700	7,900	35,670	28,500	13,280	44,380	35,480	16,060

Route 9 Site

	36/130 mgd (year 2010)			54/170 mgd (year 2040)		
Unit: kW	Connected Load ¹	Peak Demand ²	Average Demand ³	Connected Load ¹	Peak Demand ²	Average Demand ³
Influent Pump Station ⁴	12,300	9,800	1,800	14,800	11,800	2,200
Plant w/ Split MBR treatment ⁵	11,000	8,800	5,500	15,100	12,100	7,600
Plant w/ Ballasted Sedimentation ⁷	170	140	130	250	200	190
Reuse (w/UV disinfection) ^{5 & 6}	600	500	300	6,400	5,100	3,200
Total Plant + Influent Pump Station + Reuse	24,070	19,240	7,730	36,550	29,200	13,190

Notes:

- 1. Plant connected load is 110% of the total horsepower of all the equipment (10% to account for lighting and other miscellaneous uses).
- 2. Peak load is assumed to be 80% of connected load
- 3. Average load for influent or effluent pumping is assumed to be 10-15% of connected load of pumping (15% is used here, close to the pumping energy for annual average flow)
Average load for split MBR flow treatment and reuse is assumed to be 35-50% of connected load of split MBR flow treatment and reuse (50% is used here)
- 4. Connected load for pumping is calculated to include the redundant units
- 5. Connected load for split MBR flow treatment and reuse is calculated without including the redundant units
- 6. For 5 mgd reuse plant at a flow of 36, and 54 mgd reuse plant at a flow of 54 mgd and 72 mgd.
- 7. Assume the frequency of the ballasted sedimentation operation and the percentage of equipment used are:

Event/year Period/event (hr) % of equipment in operation
25 8 75%

Attachment G
Brightwater Wastewater Treatment Plant Energy Requirements
Table G-3 Average Annual Energy Consumption

Assume all units run 24-hours a day

Edmonds Unocal Site

	36/130 mgd (year 2010)		54/170 mgd (year 2040)		72/235 mgd (year 2040)	
Unit: kWh	Average Annual Consumption		Average Annual Consumption		Average Annual Consumption	
	low	high	low	high	low	high
Influent + Effluent Pump Station ¹	9,928,000	14,892,000	11,680,000	17,520,000	15,768,000	23,652,000
Plant w/ MBR Split Flow Treatment ²	34,952,400	49,932,000	47,829,600	68,328,000	60,093,600	85,848,000
Plant w/ Ballasted Sedimentation ⁴	40,000	40,000	56,000	56,000	72,000	72,000
Reuse (w/UV disinfection) ^{2 & 3}	1,839,600	2,628,000	19,622,400	28,032,000	19,622,400	28,032,000
Total Plant + Influent Pump Station + Effluent Pump Station + Reuse	46,760,000	67,492,000	79,188,000	113,936,000	95,556,000	137,604,000

Energy recovered from biogas	6,000,000	6,000,000	9,000,000	9,000,000	12,000,000	12,000,000
Net energy consumption						
Total Plant + Influent Pump Station + Effluent Pump Station + Reuse	40,760,000	61,492,000	70,188,000	104,936,000	83,556,000	125,604,000

Route 9 Site

	36/130 mgd (year 2010)		54/170 mgd (year 2040)	
Unit: kWh	Average Annual Consumption		Average Annual Consumption	
	low	high	low	high
Influent Pump Station ¹	10,512,000	15,768,000	12,848,000	19,272,000
Plant w/ MBR Split Flow Treatment ²	33,726,000	48,180,000	46,603,200	66,576,000
Plant w/ Ballasted Sedimentation ⁴	26,000	26,000	38,000	38,000
Reuse (w/UV disinfection) ^{2 & 3}	1,839,600	2,628,000	19,622,400	28,032,000
Total Plant + Influent Pump Station + Reuse	46,103,600	66,602,000	79,111,600	113,918,000

Energy recovered from biogas	6,000,000	6,000,000	9,000,000	9,000,000
Net energy consumption				
Total Plant + Influent Pump Station + Reuse	40,103,600	60,602,000	70,111,600	104,918,000

Notes:

- 1. Assume the average annual consumption for pumping ranges from 10% to 15% of connected load. The low number is 10%, the high number is 15%.
- 2. Assume the average annual consumption for plant and reuse ranges from 35% to 50% of connected load. The low number is 35%, the high number is 50%.
- 3. For 5 mgd reuse plant at a flow of 36, and 54 mgd reuse plant at a flow of 54 mgd and 72 mgd.
- 4. Assume the frequency of the ballasted sedimentation operation and the percentage of equipment used are:

Event/year	Period/event (hr)	% of equipment in operation
25	8	75%

Attachment H – Energy Recovery Potential from Biogas

Attachment H
Biogas Estimate and Energy Recovery from Biogas

	36 MGD	54 MGD	72 MGD (Unocal Only)
Digestion			
TSS (kppd) =	59	89	118
VSS (kppd) =	47	71	94
VSS reduction =	58%	58%	58%
Gas Production (Vol /wt volatile solids destroyed) (scf/lb) =	14	14	14
Biogas Production (scf/d) =	381,600	572,400	763,200
Biogas Production (cfm)	265	398	530
Energy Recovered (kW)	698.59	1,048	1,397
Annual Energy Recovery (kWh)	6,000,000	9,000,000	12,000,000

Attachment I – Cut and Fill Quantities

Attachment I						
Brightwater Treatment Plant Cut and Fill Quantities						
Table I-1 Route 9 Site						
ESTIMATED EARTHWORK QUANTITIES - CUBIC YARDS - VOLUMETRIC MEASURE						
	GROSS EXCAVATION	STRUCTURAL FILL			SELECT	EXCESS
	Overall Site	Base	Structural		BACKFILL	EXCAVATION
		Course	Fill	TOTAL		
Excavation for 36mgd MBR Plant						
Process Facilities including Admin/Maint and Canal	537,702	24,300	80,027	104,327	515,209	
Influent Pump Station	132,730			-		
Area outside process and support facilities	119,295			-		
Sub-totals:	789,727			104,327	515,209	274,518
Swell/Shrink Factors (See notes below):				+15%		+25%
Totals for Truck Haul:				119,976		343,148
Total No. of 16-cy Truck Loads:				7,499		21,447
Additional Excavation for 54mgd MBR Plant						
	90,178	3,738		3,738	12,799	77,378
Swell/Shrink Factors (See notes below):				+15%		+25%
Totals for Truck Haul:				4,298		96,723
Total No. of 16-cy Truck Loads:				269		6,046
Additional Excavation for CAS Plant						
	238,550	3,169		3,169	87,433	151,117
Swell/Shrink Factors (See notes below):				+15%		+25%
Totals for Truck Haul:				3,645		188,896
Total No. of 16-cy Truck Loads:				228		11,807
Notes:						
1. Assume 25% swell for truck haul off-site; assume 15% shrinkage for structural backfill.						
2. Assume a maximum of 70-80% of the excavation can be used for Select Backfill; assume conditioning with cement or other additives will be required for all such use.						

Attachment I				
Brightwater Treatment Plant Cut and Fill Quantities				
Table I-2 Unocal Site				
ESTIMATED EARTHWORK QUANTITIES - CUBIC YARDS - VOLUMETRIC MEASURE				
	Initial Excavation			
	to Finish Grade	STRUCTURAL	SELECT	EXCESS
	CUT	FILL	BACKFILL	EXCAVATION
Excavation for 36mgd MBR Plant	(Cu.Yds)	(Cu.Yds)	(Cu.Yds)	(Cu.Yds)
Forest Concept with Aeration Basins Slab @ Elev 165.0	1,002,855	369,796		
Additional Excavation for Structures	237,120	61,491		
Influent Pump Station	39,794			
Sub-totals:	1,279,769	431,287	-	1,279,769
Swell/Shrink Factors (See notes below):		+15%		+25%
Totals for Truck Haul:		495,979.55		1,599,711
Total No. of 16-cy Truck Loads:		30,999		99,982
Additional Excavation for 54mgd MBR Plant	85,419	12,710		85,419
Swell/Shrink Factors (See notes below):		+15%		+25%
Totals for Truck Haul:		14,616.20		106,774
Total No. of 16-cy Truck Loads:		914		6,674
Additional Excavation for 72mgd MBR Plant	86,201	9,401		86,201
Swell/Shrink Factors (See notes below):		+15%		+25%
Totals for Truck Haul:		10,811.03		107,751
Total No. of 16-cy Truck Loads:		676		6,735
Additional Excavation for CAS Plant	319,875	131,535		319,875
Swell/Shrink Factors (See notes below):		+15%		+25%
Totals for Truck Haul:		151,265.31		399,844
Total No. of 16-cy Truck Loads:		9,455		24,991
Notes:				
1. Assume 25% swell for truck haul off-site; assume 15% shrinkage for structural backfill.				
2. Assume a maximum of 70-80% of the excavation can be used for Select Backfill; assume conditioning with cement or other additives will be required for all such use.				

Attachment J – Truck Trips for Plant Operations

Attachment J

Brightwater Wastewater Treatment Plant Truck Trips for Plant Operation

Table J-1 Chemical Dosage and Quantities

Process	Chemical Required	Approx. Dose Required	Approx. Total Chemical Required per Year	Approx. Total Chemicals Required per Year	Approx. Total Chemicals Required per Year	Notes
			36 MGD	54 MGD	72 MGD (Unocal only)	
Odor Control in Influent Tunnel to maintain H2S no more than 0.5 ppm	Bioxide	1.5 gal Ca(NO3)2/lb sulfide	120,000 gal/yr	180,000 gal/yr	240,000 gal/yr	Total sulfide removed by Bioxide from interceptor model = 266 lbs/day @ 36 mgd, say 300 lb S/day. Assume using bioxide 9 months a year.
Ballasted Sedimentation	Ferric chloride	100 mg/L	33,095 gal/yr	49,643 gal/yr	66,190 gal/yr	200 MG/year flow treated by ballasted sed. Ferric at a 42% solution
Prechlorination	Sodium hypochlorite	10 parts chlorine to one part of sulfide	313,760 gal/yr	470,639 gal/yr	627,519 gal/yr	12.5% solution
Chemical Disinfection for Puget Sound Discharge at Route 9	Sodium hypochlorite	2.0 mg chlorine /L for MBR effluent. 10 mg chlorine/L for ballasted sed. Effluent	210,800 gal/yr	316,200 gal/yr		12.5% solution, about 1 gallon provides 1 lb chlorine
Chemical Disinfection for Puget Sound Discharge at Unocal (for split stream)	Sodium hypochlorite	10 mg chlorine/L for ballasted sed. Effluent	4,170 gal/yr	6,255 gal/yr	8,340 gal/yr	
Chemical Disinfection for Puget Sound Discharge at Route 9	Sodium bisulfite	1.0 mg/L at peak week flow	51,000 gal/yr	77,000 gal/yr	NA	38% solution, 3.5 lb of sulfite/gal. Dose will vary depending on the actual chlorine residual
Chlorination for UV Disinfected Reuse Water (assume 5 mgd reuse at 36 mgd plant and 54 mgd reuse at 54 mgd plan)	Sodium hypochlorite	1 mg chlorine /L	15,000 gal/yr	162,000 gal/yr	162,000 gal/yr	12.5% solution, about 1 gallon provides 1 lb chlorine
Sludge Thickening	Polymer	6-7.5 dry lb / dry ton solids	92,000 lb/yr	138,000 lb/yr	184,000 lb/yr	The total chemical amount based on max. dose
Sludge Dewatering	Polymer	30 dry lb / dry ton solids	186,000 lb/yr	279,000 lb/yr	372,000 lb/yr	
Odor Control	Virgin Activated Carbon		226,000 lb/yr	300,000 lb/yr	370,000 lb/yr	Polisher for three-stage scrubber and digester building
	Sodium Hydroxide		1,083,000 gal/yr	1,624,500 gal/yr	2,166,000 gal/yr	50% solution. Three-stage scrubber

Attachment J

Brightwater Wastewater Treatment Plant Truck Trips for Plant Operation

Table J-1 Chemical Dosage and Quantities

Process	Chemical Required	Approx. Dose Required	Approx. Total Chemical Required per Year	Approx. Total Chemicals Required per Year	Approx. Total Chemicals Required per Year	Notes
	Sodium Hypochlorite		106,000 gal/yr	159,000 gal/yr	212,000 gal/yr	12.5% solution. Three-stage scrubber
	Sulfuric Acid		11,785 gal/yr	17,678 gal/yr	23,570 gal/yr	98% Solution. Three-stage scrubber
Membrane Cleaning	Sodium hypochlorite		70,900 gal/yr	70,900 gal/yr	70,900 gal/yr	12.5% solution
	Citric Acid		15,000 gal/yr	15,000 gal/yr	15,000 gal/yr	99% - 100% solution, 13.8 lb/gal density
	Sodium Hydroxide		21,000 gal/yr	21,000 gal/yr	21,000 gal/yr	50% solution, 12.8 lb/gal density.
	Sodium bisulfite		11,000 gal/yr	11,000 gal/yr	11,000 gal/yr	38% solution, 3.5 lb of sulfite/gal.

Note: Applicable for both plant sites unless specified.

Attachment J

Brightwater Wastewater Treatment Plant Truck Trips for Plant Operation

Table J-2 Chemical Total Quantities and Number of Round Trip Truck Loads

	Total Quantities			Number of truck loads			Notes
	36 mgd	54 mgd	72 mgd (at Unocal Site)	36 mgd	54 mgd	72 mgd (at Unocal Site)	
Hypochlorite (for disinfection, odor control, prechlorination and postchlorination)				Liquid (Tanker trucks/month)			Hypo s.g.=1.17, assume 4800-gallon tanker truck.
at Unocal	509,830 gal/yr	868,794 gal/yr	1,080,759 gal/yr	9	16	19	
at Rt. 9	716,460 gal/yr	1,178,739 gal/yr	NA	13	21	NA	
Sodium hydroxide	1,104,000 gal/yr	1,645,500 gal/yr	2,187,000 gal/yr	20	29	38	Assume 4800-gallon tank
Sulfuric acid	11,785 gal/yr	17,678 gal/yr	23,570 gal/yr	1	1	1	Assume 4800-gallon tank
Citric acid	15,000 gal/yr	15,000 gal/yr	15,000 gal/yr	1	1	1	Assume 4500-gallon tank
Ferric Chloride (for ballasted clarification)	33,095 gal/yr	49,643 gal/yr	66,190 gal/yr	1	1	2	Ferric solution s.g. = 1.5, assume 4500-gallon tanker truck due to higher density
Sodium Bisulfite (at Rt.9)	62,000 gal/yr	88,000 gal/yr		2	2	NA	s.g. = 1.3. Assume 4500-gallon tank due to higher density
at Unocal	11,000 gal/yr	11,000 gal/yr	11,000 gal/yr	1	1	1	
Calcium Nitrate (Bioxide)	120,000 gal/yr	180,000 gal/yr	240,000 gal/yr	2	3	4	Assume 4800-gallon tank delivered off-site to pump station.
Dewatering polymer	186,000 lb/yr	279,000 lb/yr	372,000 lb/yr	1	1	1	Assume truck load = 20 ton
Thickening polymer	92,000 lb/yr	138,000 lb/yr	184,000 lb/yr	1	1	1	
Carbon	226,000 lb/yr	300,000 lb/yr	370,000 lb/yr	6	8	10	Neglect trucks for carbon, since it does not occur often
Total Round Trip Truck Loads (trucks/month)							
at Unocal				37	54	68	
at Rt. 9				42	60	NA	

Note: Applicable for both plant sites unless specified.

Attachment J

Brightwater Wastewater Treatment Plant Truck Trips for Plant Operation

Table J-3 Number of Screenings/Grit and Biosolids Truck Loads

Biosolids			
AWWF mgd	36 mgd	54 mgd	72 mgd (Unocal Only)
Coarse Screenings, Grit and Fine Screenings			
TSS, kppd	5	7.5	10
VSS, kppd	4	6	8
wet ton /day	4.5	6.75	9
cu yd /day	5.5	8.25	11
20 ton truck/week	2	3	4
Biosolids			
TSS, kppd	32	48	64
VSS, kppd	20	30	40
wet ton /day	64.4	96.6	128.8
cu yd /day	76.4	114.6	152.8
32 ton truck/day	2	3	4

Attachment K – Unocal Lid Sub-Alternative for Unocal Site

ATTACHMENT K - Unocal Stormwater Marine Discharge

INTRODUCTION

This attachment summarizes the conceptual design for a multiuse lid for the Unocal site. This conceptual design has been developed to ensure that the multimodal transportation facility proposed by the State of Washington Department of Transportation and the City of Edmonds (Edmonds Crossing) could be co-located at the Unocal site with the Brightwater Treatment Plant. In addition, a preliminary structural analysis was performed to determine the beam and column sizing for the lid.

CONCEPTUAL DESIGN

The Brightwater Treatment Plant facilities would occupy the majority of the usable area of the site and therefore any co-located facility, such as the Edmonds Crossing project, would be constructed on top of a lid above the treatment facilities. A brief narrative description and key design assumptions of the lid follow; conceptual sketches and cross-section drawings are provided at the end of this attachment. The concept is shown for the 72-mgd sub-alternative, with the assumption that the column pattern for the 54-mgd plant would be the same as for the 72-mgd plant.

Multimodal Terminal/Lid Description

The lid would be a concrete structure built on piles and open below. It would cover approximately 20 acres of the Unocal site and would be elevated approximately 30 feet above the operating treatment units below. The conceptual design has been developed assuming the use of rectangular aeration basins, rectangular membrane tanks, and potential future circular secondary clarifiers. Based on the foundation materials expected onsite, a pile foundation system would be required to support the lid. Two pile grid patterns have been developed:

- 1) 40 ft by 176 ft grid that would be located over the circular secondary clarifiers. The piles in this grid would be located between the clarifiers and would be independent of the structures.
- 2) 52 ft by 52 ft grid that would be located over the rest of the area under the lid, which includes aeration basins, other rectangular tanks and buildings, and roads. These piles would be integrated into the structures (aeration basins, membrane tanks, membrane support building, etc.) to the greatest extent feasible.

Key Design Assumptions

- Traffic to and from the ferry terminal would enter and exit the lid at approximately the same elevation as the existing SR-104 and Pine Street intersection (elevation 50).

- Once on the lid, vehicles could enter the ferry lanes, bus terminal, or parking lot.
- The rail terminal below would have pedestrian access from the lid.
- Design concepts beyond the railroad would be similar to those developed by the Edmonds Crossing project and are beyond the scope of this description.
- The elevation of the lid must accommodate maintenance of treatment plant facilities below (assume 20 to 30 feet of clearance).
- The ferry traffic would cross the Burlington Northern–Santa Fe (BNSF) railroad at elevation 50.
- Pile foundations would be required to support the loads. The piles are assumed to be filled with concrete to resist long-term corrosion and provide lateral resistance. Other options might be considered during design to reduce costs.
- Pile foundations in the vicinity of large process tanks would be integrated into the process tank walls.
- Cast-in-place concrete would be used for the structure. (Note that due to time and budget constraints, no attempt has been made in this conceptual design to evaluate alternative structural concepts such as precast, pre- or post-tensioned, or composite systems.)
- Columns would be sized for seismic loads. Use of shear walls is a refinement that may be considered in subsequent design.
- Preliminary live loads used for design for the various areas were:
 - Parking and other areas 100 psf
 - Ferry holding and bus turnaround 225 psf
 - Landscaped areas with minimal plantings 180 psf
- Preliminary seismic criteria used: 1997 UBC, Seismic Zone 3, $V/W = 0.20$.

Multimodal Considerations

The Edmonds Crossing conceptual design titled “Revised Point Edwards Alternative” was used in the development of the lid concept. The complete functionality of the Edmonds Crossing facility is incorporated into the conceptual lid design. The following components are included:

- Ferry holding lanes (7 total)
- Ferry traffic exit lanes (2 total)
- Bus terminal
- Rail terminal (below lid)
- Short-term, long-term, and employee vehicle parking (580 spaces total)

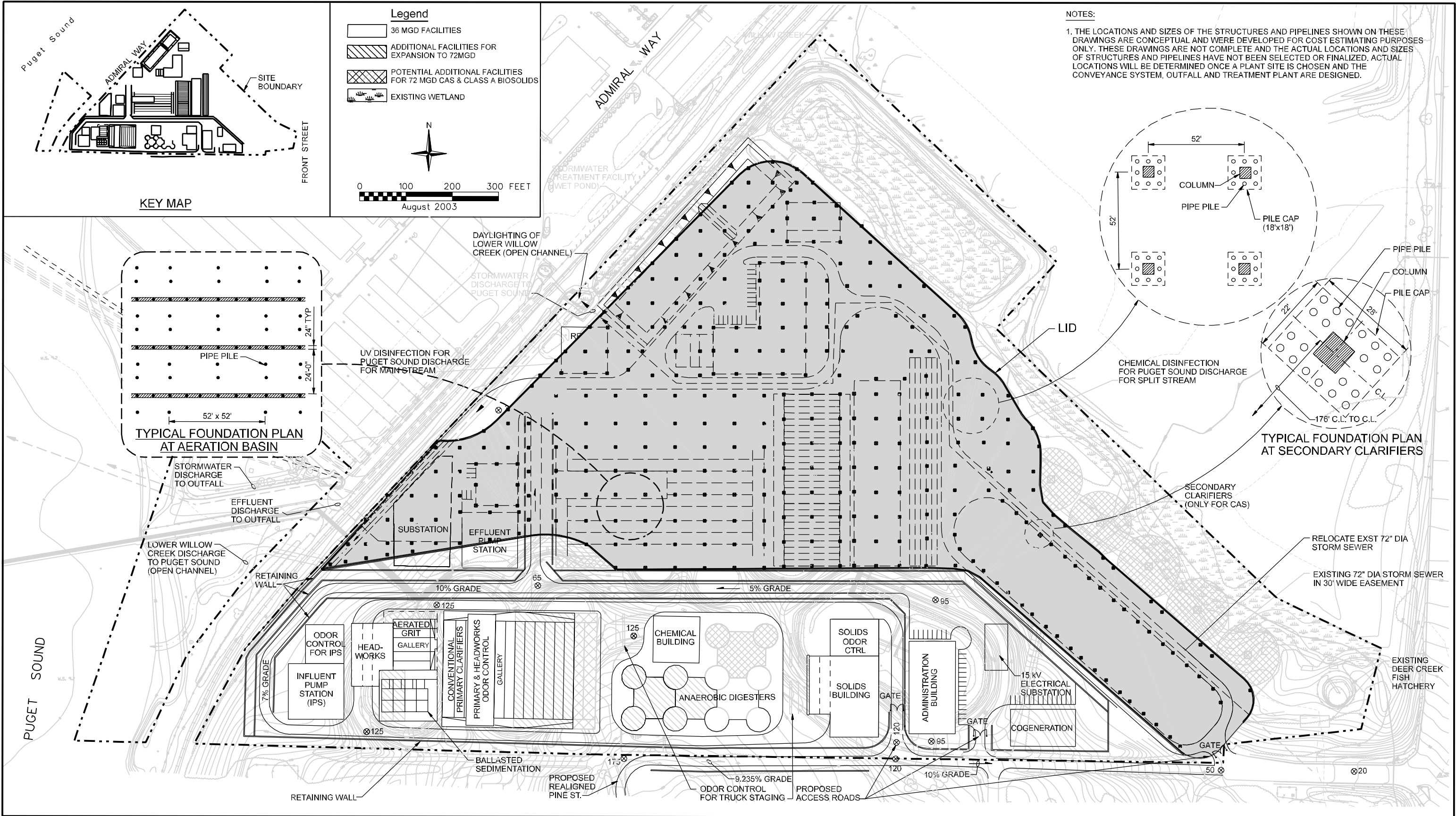
- Pedestrian access (elevator and escalator/stairs) to transport passengers from the ferry or bus terminal on the lid to the rail terminal below
- Stormwater from the lid treated in the treatment plant's stormwater ponds
- Four toll booths with an office above
- Bus stops and bus turnaround on Admiral Way

FIGURES

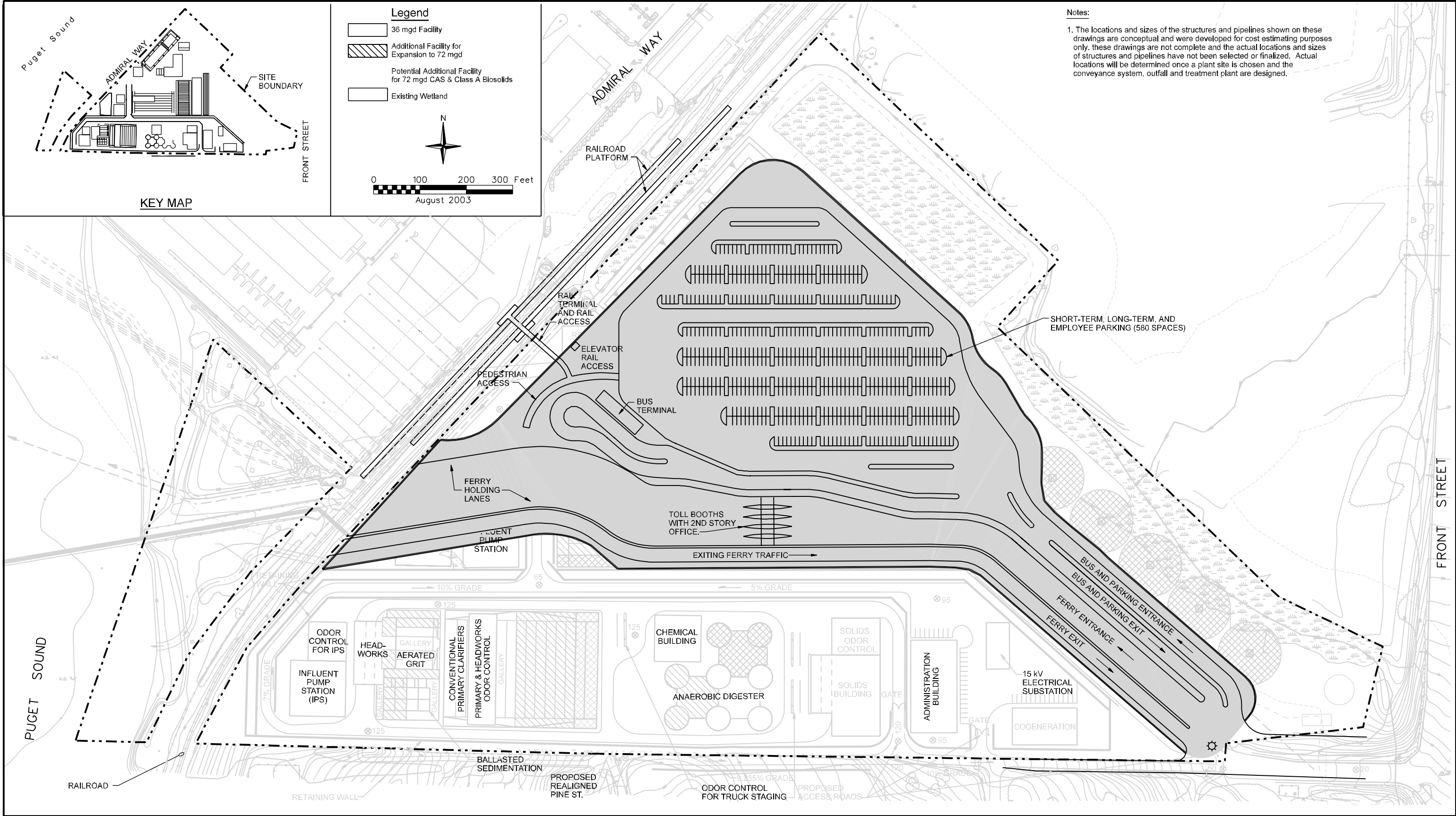
- K-1 Unocal 72 mgd Plant with Lid and Column Spacing
- K-2 Lid with Multi-Modal Facilities
- K-3 Typical Lids Section over Secondary Clarifiers – 176 x 40 Grid
- K-4 Typical Lid Section – 52 x 52 Grid, over Aeration Basins and over Empty Space

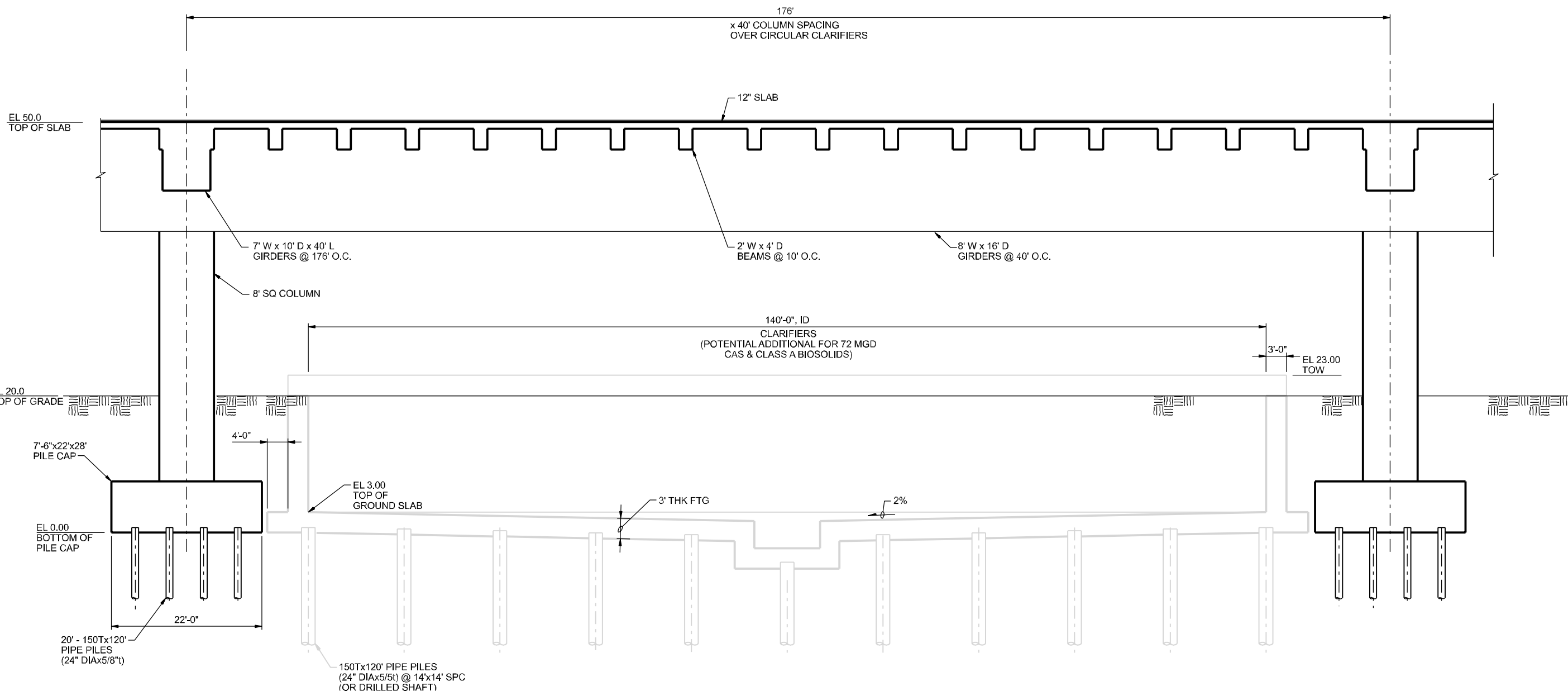
REFERENCES

Edmonds Crossing Project Update flyer, January 2003.



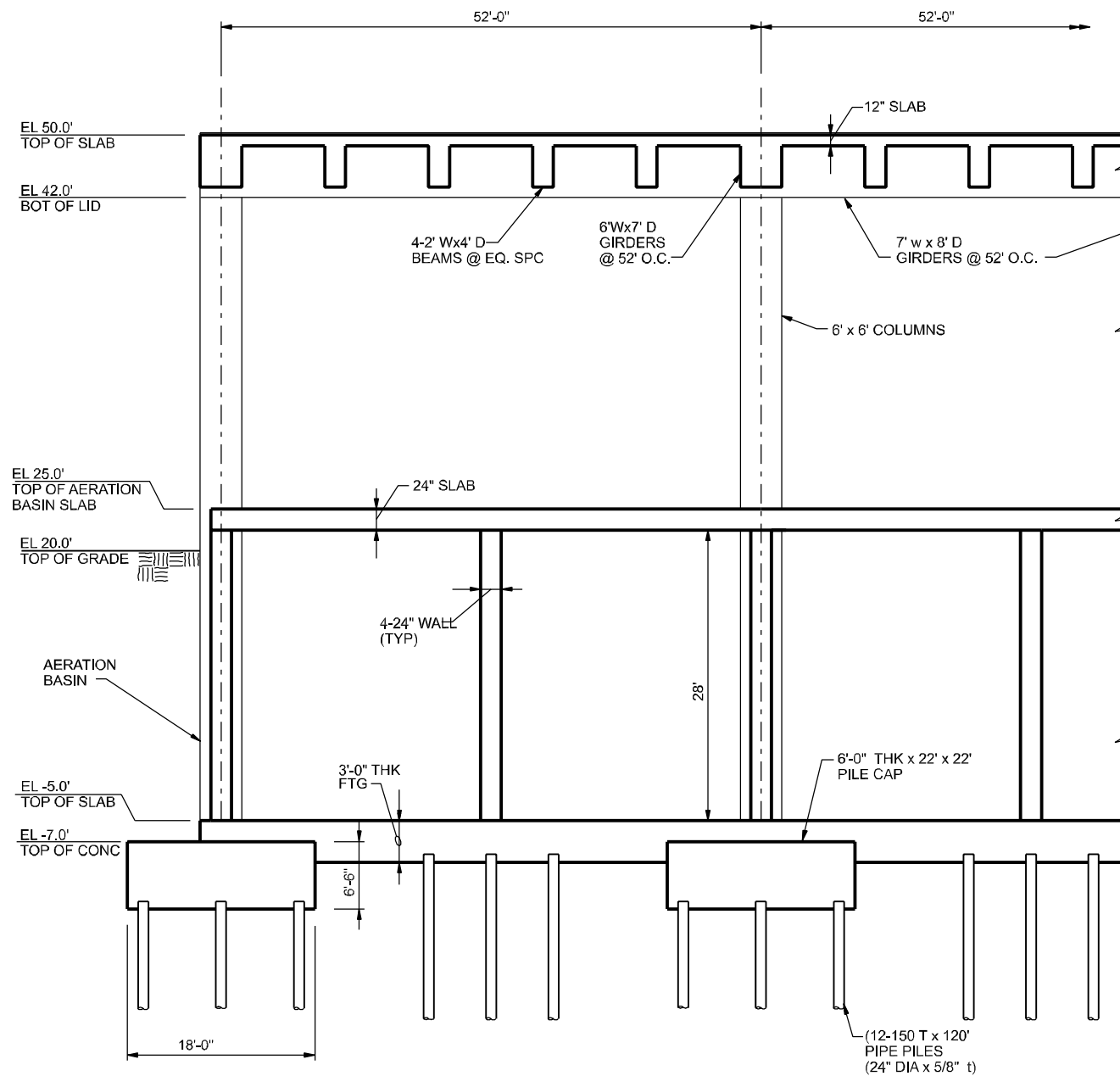
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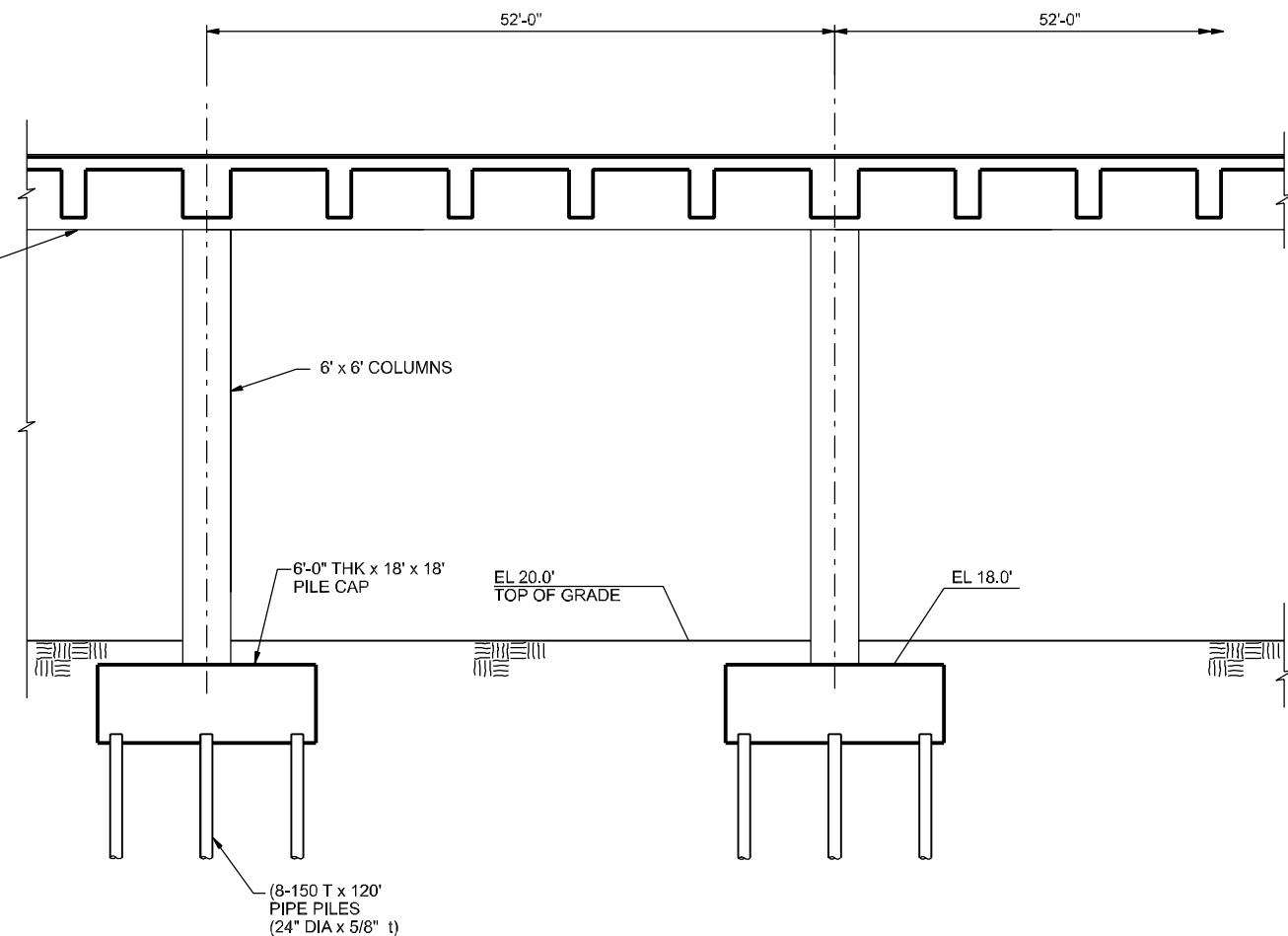


TYPICAL SECTION - 176' x 40' BAYS
 1/16"=1'-0"

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**TYPICAL MULTI-MODAL LID SECTION
OVER AERATION BASIN**
1/16"=1'-0"



TYPICAL MULTI-MODAL LID SECTION
1/16"=1'-0"



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Figure K-4

Unocal - Typical Multi-Modal Lid Section
*BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM*

Attachment L – Pine Street Relocation Evaluation Attachment

ATTACHMENT L – Pine Street Location, Unocal Site

INTRODUCTION AND SUMMARY

This attachment investigates the proposed Pine Street relocation as part of the Brightwater Unocal site development and its impact on the existing access to the Town of Woodway.

Pine Street would need to be realigned to maintain access to Woodway during and after construction on the Unocal site. The street would be realigned to the south along the Unocal property line and would continue west from the intersection of SR-104. The existing curve in the roadway that extends into the Unocal site would be eliminated. Retaining walls would be constructed to stabilize the slope after excavation. The roadway section and grade requirements would be constructed to county and city roadway design standards. The project would take approximately 6 to 8 months to complete. During this construction period, construction vehicles would occasionally travel with neighborhood traffic to access the construction area. Flaggers would be onsite to assist all site access and minimize conflicts and traffic delays.

Access to Woodway and access for emergency vehicles would be maintained at all times during construction of this new roadway segment. After completion of the newly realigned Pine Street, local neighborhood traffic would be rerouted permanently to the new roadway. The realignment is not expected to cause delays during peak traffic conditions, and no changes to the traffic operating level of service would occur.

ROADWAY

According to the Snohomish County and City of Edmonds design standards, the maximum grade is 12 percent for nonarterial collectors and subcollectors, and 15 percent for nonarterial access streets. The streets accessing Woodway from Pine Street are Chinook Road (117th Place W) and Nootka Road. A conceptual layout of the roadway option is illustrated in the attached drawing (Figure L-1), and the impacted roadway grades are summarized below:

Street Name	Existing grade	Proposed grade
Chinook Road (117 th Place W)	6.95%	6.95%
Nootka Road	6.50%	6.50%
Pine Street	9.07%	9.25%

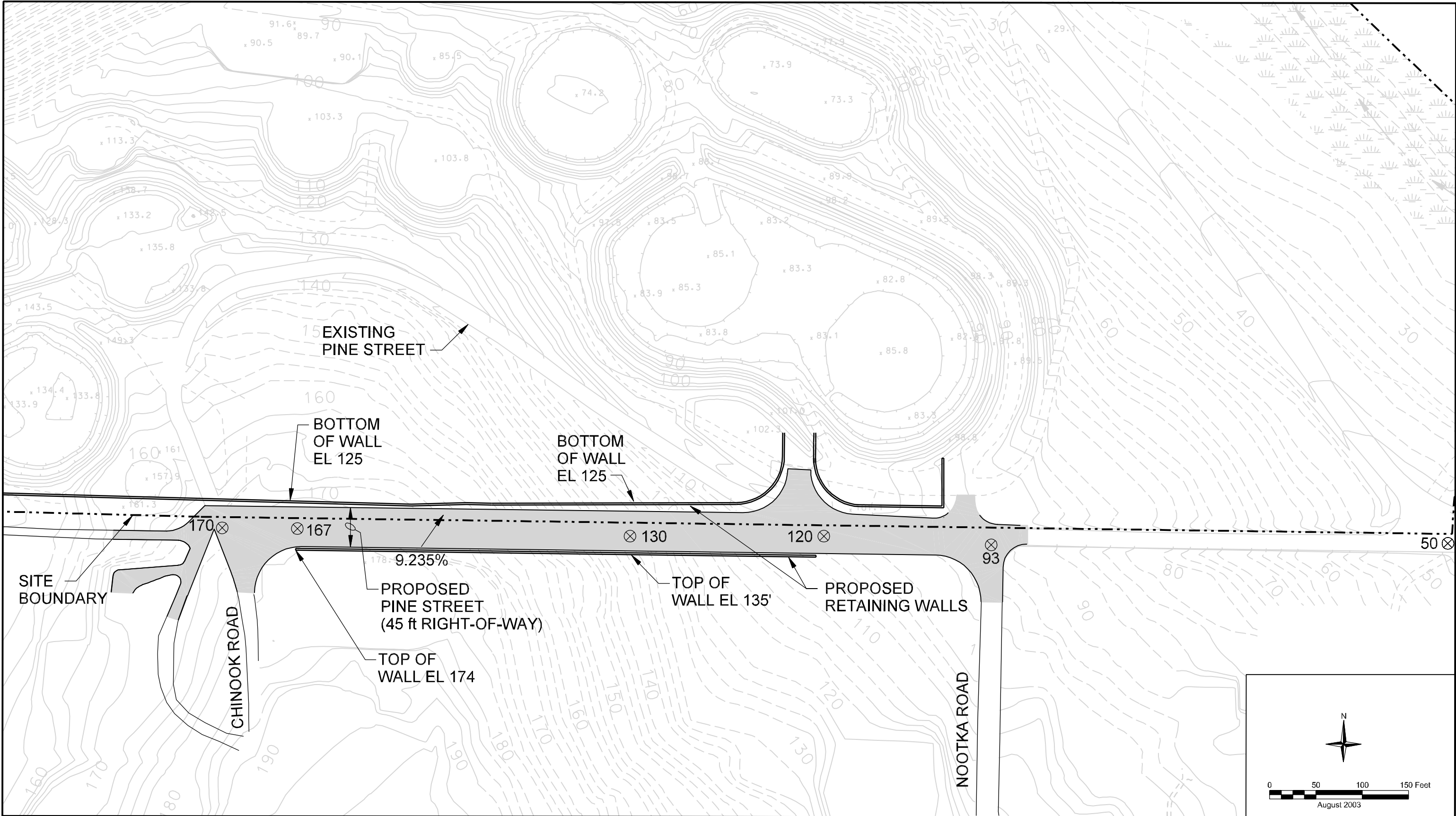
The elevation at the intersection of Chinook Road and Nootka Road with the realigned Pine Street would remain the same as the existing elevation. The grade on the realigned Pine Street would be 9.25 percent, while maintaining the existing

elevation at the tie-in points of Chinook Road and Pine Street and also Nootka Road and Pine Street:

- a) The elevation at the intersection of Chinook Road and the realigned Pine Street would remain at 170 feet. There would be no impacts to driveways on Chinook Road.
- b) The elevation at the intersection of Nootka Road and the realigned Pine Street would remain at 93 feet. There would be no impacts to driveways on Nootka Road.

RETAINING WALLS

Retaining wall elevations are based on proposed elevations on Pine Street and the bench cut on the treatment plant site at 125 feet. The bench cut would be for the primary clarifiers and the anaerobic digesters. The exposed height of the retaining wall on the north side of Pine Street would vary from 0 to 50 feet above the bench elevation of 125 feet and 2 feet above the finish grade of Pine Street. A retaining wall would also be required on the south side of Pine Street. The exposed wall height on the south side would vary from approximately 0 to 22 feet.



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M – Unocal Pile Foundation

ATTACHMENT M – UNOCAL PILE FOUNDATION

INTRODUCTION

This attachment presents the conceptual foundation design for the structures at the lower yard of the Unocal site for the base alternative – no multimodal lid. A preliminary structural analysis was performed to determine the number of piles and the thickness of the concrete mat foundation for the treatment plant facilities only.

CONCEPTUAL DESIGN

The draft conceptual geotechnical report for Brightwater facilities (King County, 2002) recommends deep pile foundations for the structures at the lower yard. High groundwater level and granular soils provide the optimum condition for liquefaction during an earthquake. The structures at the lower yard may also be subject to a large buoyancy force if the base of the structure is below the finished grade.

DESIGN ASSUMPTIONS

A preliminary structural analysis was performed assuming the following loading conditions:

- Uplift force (liquefied condition) was defined as the total unit weight of the soil-water mixture (assumed to be 120 lb per cubic foot) times the water depth. Ground Water Level is assumed to be at elevation 10.0 feet.
- Concrete specific weight equals 150 lb per cubic foot.
- Superstructure self-weight was assumed to be 120 lb per square foot per floor. The story height was assumed to be 12 feet.
- Superimposed Live Load was assumed to be 100 lb per square foot per floor. The live load was not considered to balance the buoyancy forces.

FOUNDATION DESCRIPTION

Piles were assumed to be 24-inch-diameter steel pipe with 5/8-inch wall thickness. The soil report estimated the bearing stratum at depths of 50 to 120 feet, so 120-foot-long piles were assumed. The vertical capacity of a pile was estimated to be 150 tons in compression. The uplift pile capacity was estimated as 90 tons for a pile spacing of 8d (16 feet). Proportional reduction of the uplift capacity was considered for smaller pile spacing.

Two types of structure were identified: basement type and shallow type. Basement-type structures have their foundations considerably below the finished grade. For water-holding structures, the maximum buoyancy forces are present when the structure is empty. Examples of this type of structure are the membrane bioreactor (MBR) support building, the chemical disinfection facility, the aeration basin, and the secondary clarifiers.

Shallow-type structures have their foundations just below the finished grade and will only be required to resist gravity forces; therefore, piles will only resist compressive loads. Examples of this type of structure are the electrical substation and the maintenance building.

This preliminary pile design did not study the possibility of the loss of lateral support from the surrounding soils during a state of soil liquefaction. The piles were assumed to be filled with concrete to resist long-term corrosion and provide lateral resistance. Other options might be considered during design to reduce costs.

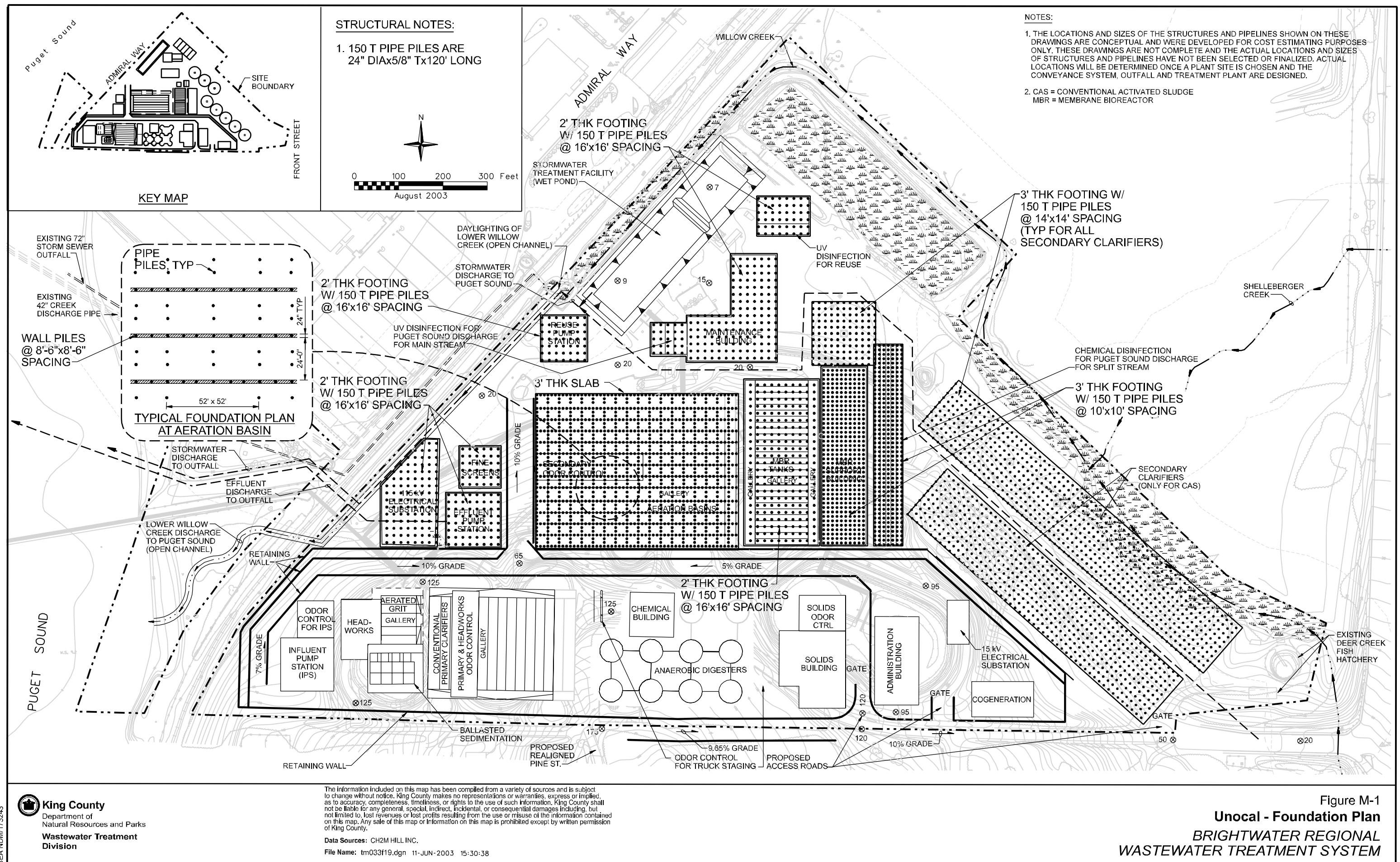
The minimum mat foundation thickness was assumed to be 24 inches in order to anchor the pile to the slab for the uplift condition and to control deflections and punching shear. The option to locally increase the thickness of the mat foundation, including use of drop panels and foundation beams, will be investigated during design development to determine whether those options are efficient and economical.

FIGURES

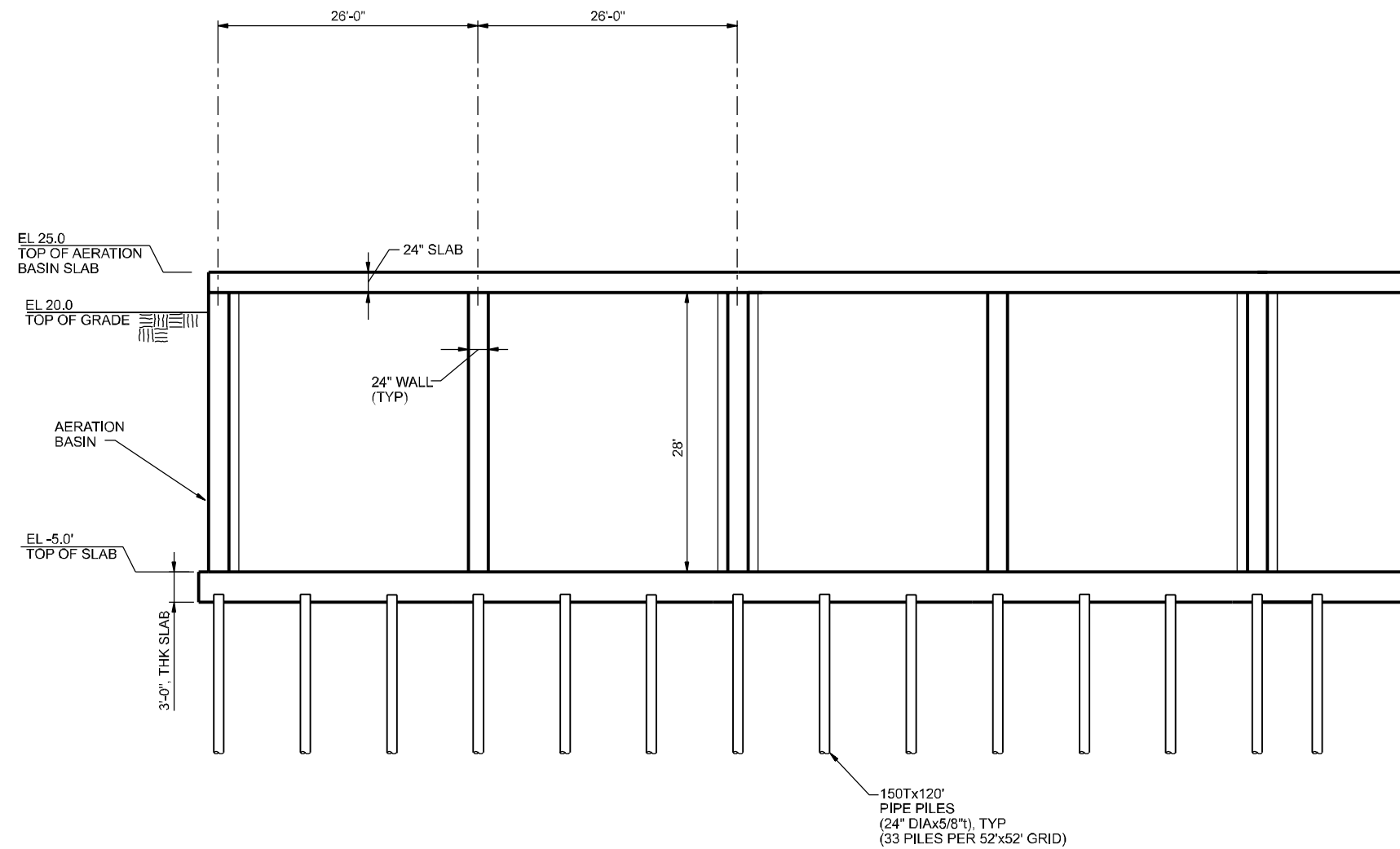
- M-1 Unocal Foundation Plan
- M-2 Unocal Typical Section - Aeration Basins
- M-3 Unocal Typical Section - Secondary Clarifiers
- M-4 Unocal Typical Sections

REFERENCES

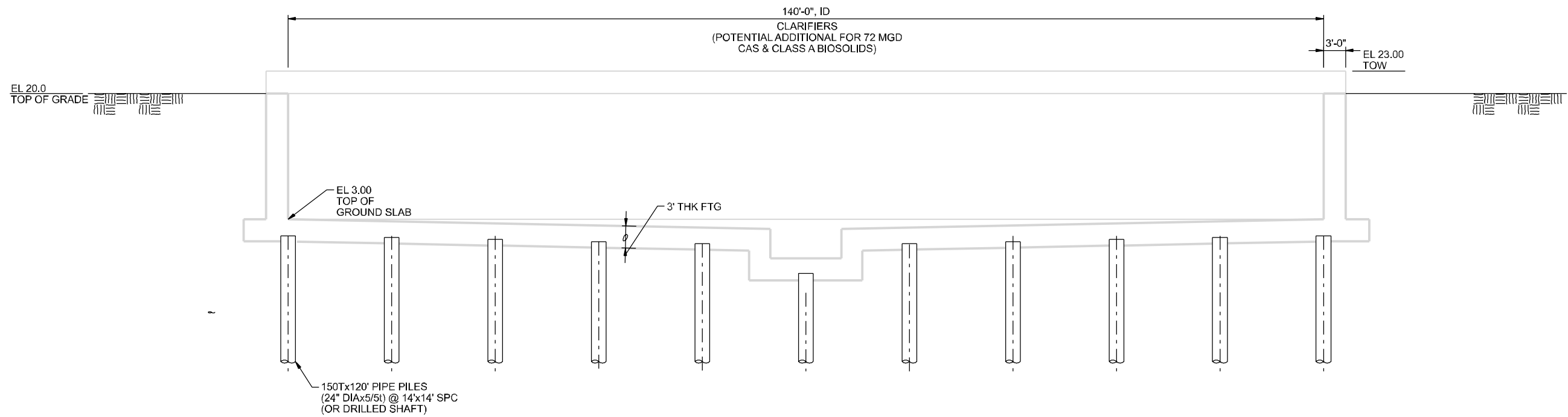
King County. 2002. Brightwater Treatment Facility, Siting Study Phase 3 Conceptual Geotechnical Report (Draft), Route 9 Site and Edmonds-Unocal Site. June 2002.



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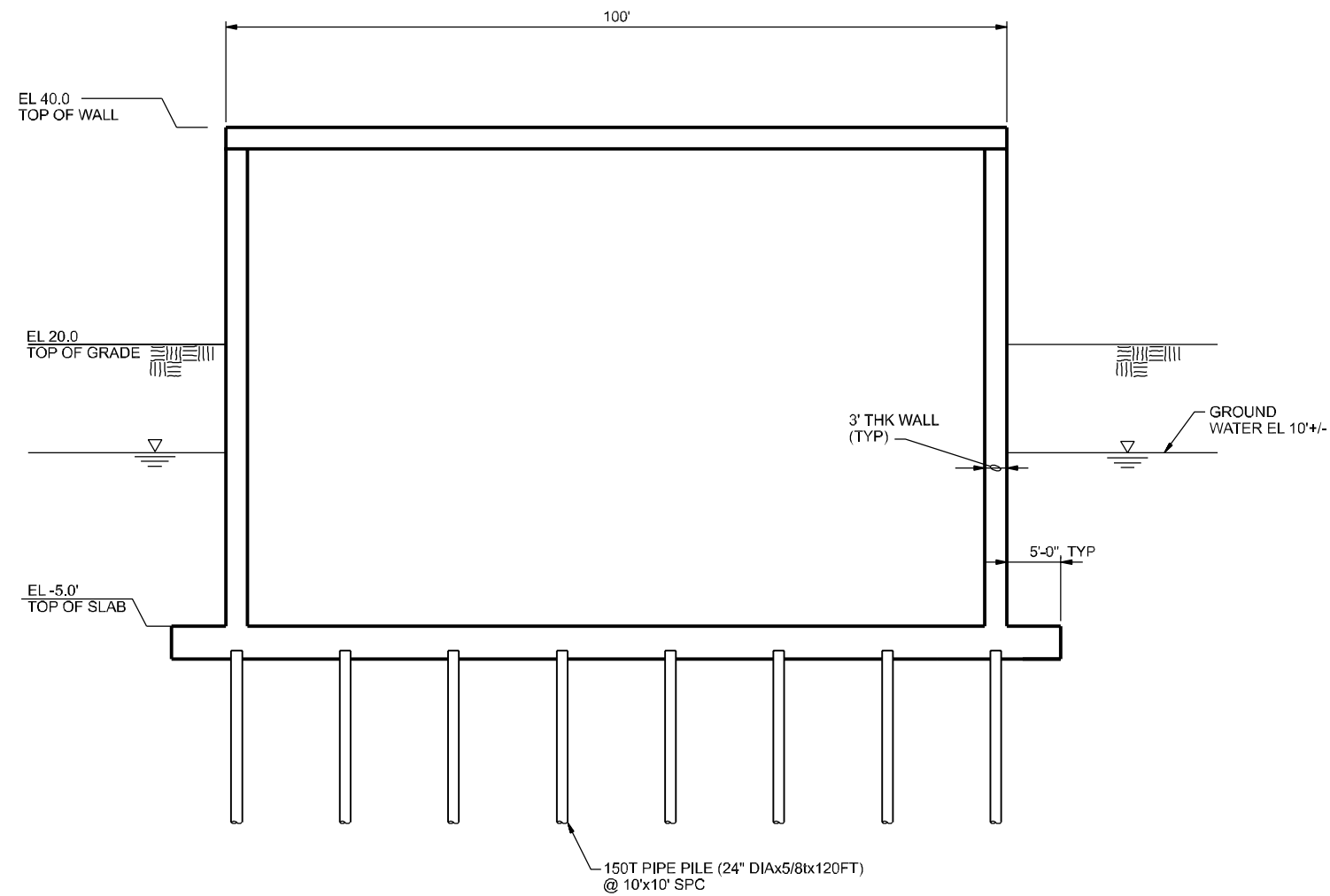


TYPICAL SECTION - AERATION BASIN
1/16"=1'-0"

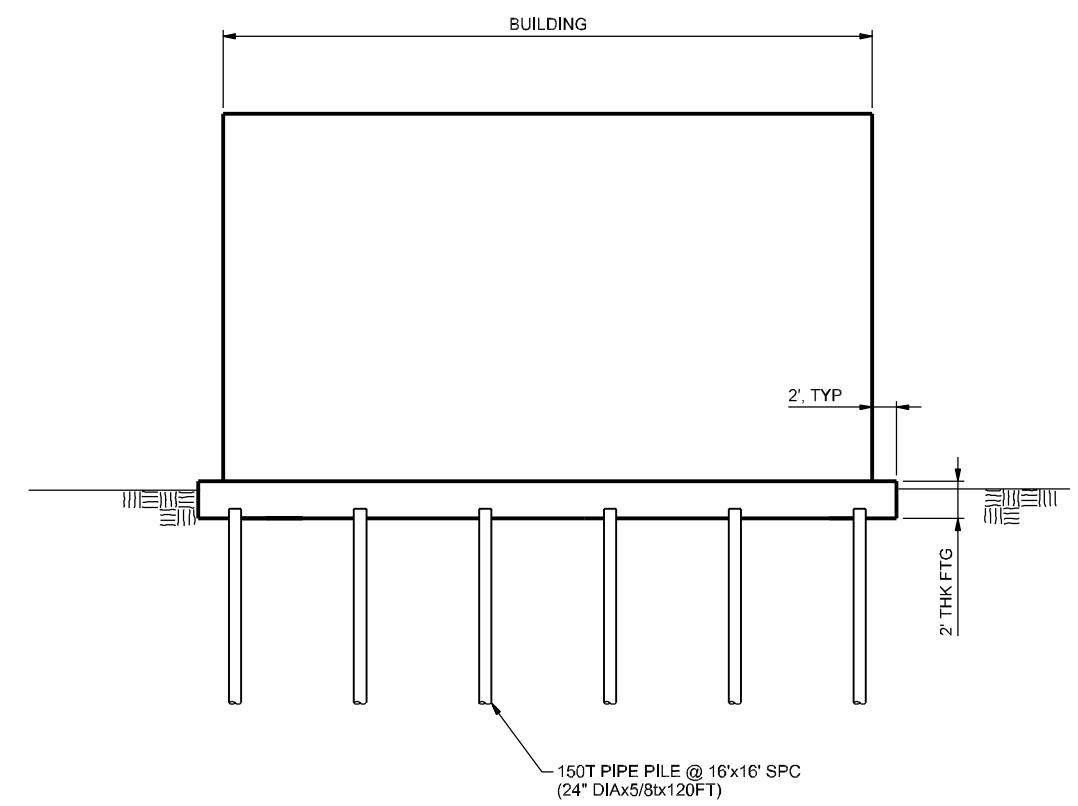


TYPICAL SECTION - SECONDARY CLARIFIERS
 1/16"=1'-0"

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**TYPICAL SECTION - MBR SUPPORT BUILDING
(SIMILAR FOR CHEMICAL DISINFECTION)**
NTS



TYPICAL SECTION - SHALLOW FOUNDATIONS
NTS



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Figure M-4
Unocal - Typical Sections
**BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM**

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